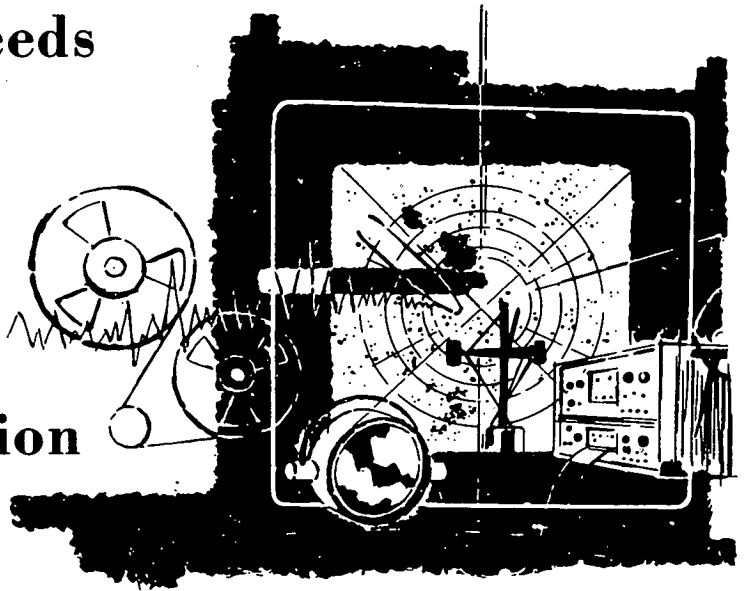


**Research Needs
for
Evaluating
Urban
Public
Transportation**



Special Report 155

Transportation Research Board

TRB

National Research Council

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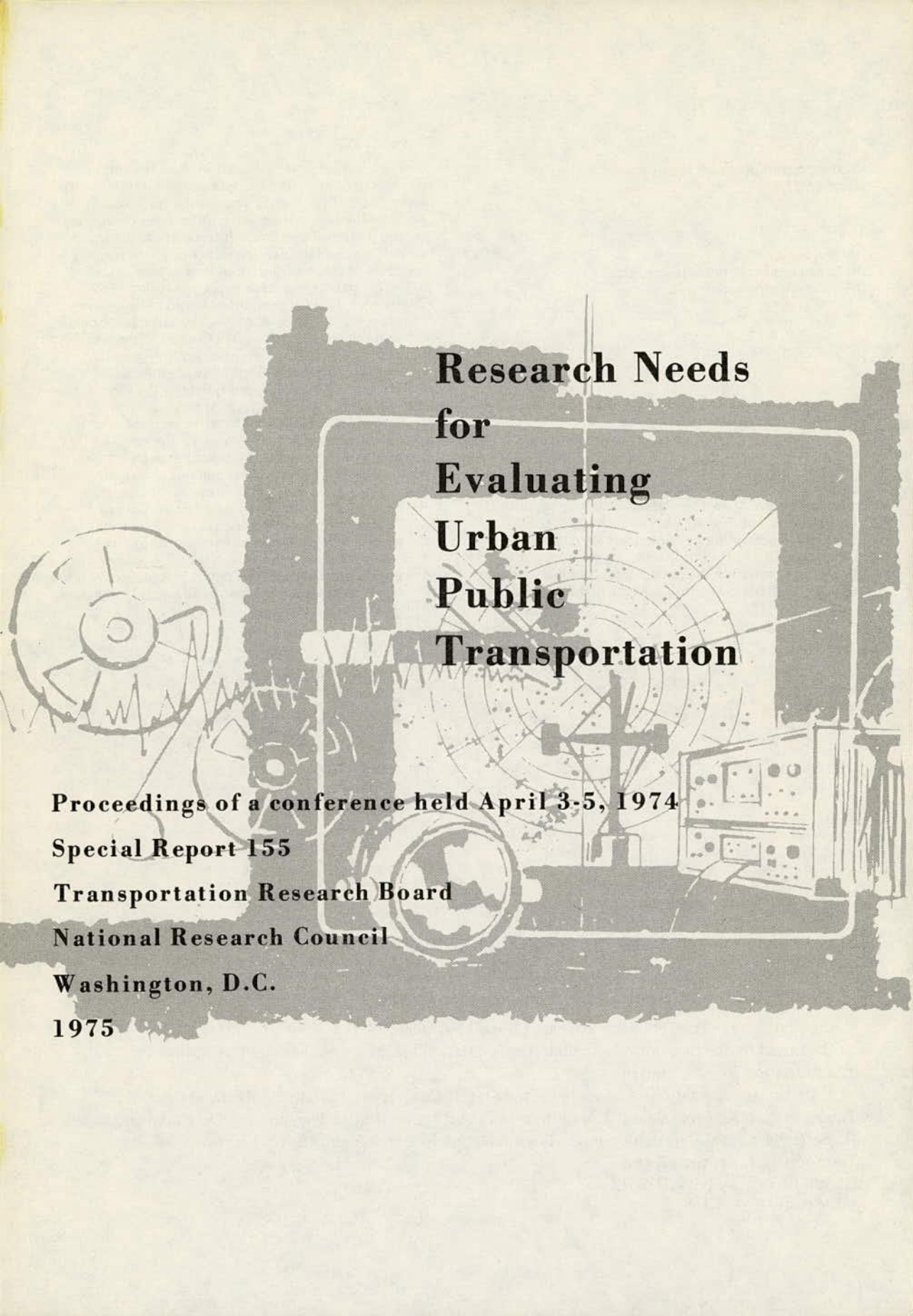
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FOREWORD

A major function of all Transportation Research Board committees is to identify research needs in the subject area of the committee's competence. Most committees perform this task as a continuing activity throughout the year. The Committee on Public Transportation Planning and Development, however, organized a 3-day conference to devote total attention to the research needed for evaluating urban public transportation.

The first afternoon of the conference was set aside for introductory reports by key participants. Five formal presentations each addressed the need for evaluation from different perspectives. The remainder of the conference time was spent in small workshop groups where the productive work of the meeting was accomplished. The workshops were organized to give each participant a chance to put himself in the decision-making role of a planner, an operator, a local policy-maker, a grantor, or a user to determine the evaluation process necessary for effective decision-making.

This Special Report contains the results of the conference. There is an introductory survey of the need for evaluation of urban public transportation, followed by the five formal papers presented to the conference as a setting for the workshop discussions. Each of the workshops was asked to prepare a report describing the general discussions and any consensus reached. On the final morning of the conference the workshop chairmen presented these reports at a plenary session. The workshop reports are included in this publication.

The conferees chose not to reach an overall conference consensus or assign overall priorities of research project needs. It was agreed that project priorities assigned by the various workshops should be documented appropriately. Research funding agencies will, of course, exercise their own prerogatives in selecting needed research.

The important products of the workshop groups are the 57 research project statements in Part IV of this Special Report. The individual workshops developed the research statements independently, and thus there are certain overlaps in various tasks of the research called for. An index has been provided as a cross-reference to the subject topics of the research project statements. The conferees were not reticent in designation of costs, priorities, and establishment of research urgency. The total suggested costs to undertake all the identified research in the 57 projects amount to nearly \$8,000,000.

By the time this Special Report reaches some readers a number of the suggested research projects will have been funded or may be in the research proposal stages. Potential users of the project statements should review current research in progress.

Part I
INTRODUCTION

THE NEED FOR EVALUATION

Kenneth W. Heathington, Transportation Research Center, University of Tennessee, and
W. Campbell Graeb, Transportation Research Board, National Academy of Sciences

ALTHOUGH planning is not an exact science, it does have a defined methodology that suggests that several basic steps are necessary for adequate planning. First, the planner must identify his client and determine the client's goals; second, the planner must realistically determine whether the client's goals can be accomplished at a reasonable cost; and third, once the product or facility has been developed, the planner must evaluate it to see if it actually meets the desires of the client. This is especially true in the case of product and service offerings, since they can be continually changed or modified to make them more effective. Oftentimes the role of the planner and operator is distorted, especially when the major goal may be the vying for state and federal funds.

The political leaders in an urban area work to formulate goals and policies for mass transit in their specific communities. From these goals, planners attempt to develop strategies and facilities that can be implemented by the transit operators. The overall effectiveness of the effort can be determined by evaluation measures that indicate how well the goals are being accomplished. The state and federal grantors are primarily interested in facilitating these efforts by providing funds and ensuring their effective use.

In practice, however, local policy-makers often recognize their unfamiliarity with mass transportation and turn to planners and operators for direction on setting goals. Planners, on the other hand, in their search for hard-to-define goals and objectives that should be provided by the policy-makers, have turned their attention to widely applicable "service standards". At times these service standards have been used blindly. If goals are stated, they frequently are formulated to satisfy funding requirements and are very broad and general.

Operators faced with rapidly rising deficits, declining ridership, and lack of specific direction from local authorities often feel that continuing the existing operating procedures is the safest course to follow, especially since more and more attention is being given to a service orientation for transit similar to police and fire services.

The user in his quest for better service has had difficulty in making the local governmental authorities, or the transit operator, respond to his needs. The local citizen or potential user is now requested to pay for services that he often does not have access to.

State and federal grantors are beginning to realize that each community has different needs and that specific funding programs frequently stimulate transit systems that maximize the inflow of grants rather than the provision of service to the community. Consequently, grantors are increasingly turning their emphasis to the use of block grants, where local agencies will have more flexibility in the allocation of funds. Unfortunately, unless the planning and evaluation procedures in urban areas are brought into better perspective, the increased funding flexibility may produce more confusion than effective solutions to urban transportation problems.

Until the early 1960s responsibility for urban mass transportation was left primarily to private enterprise. Private ownership provided ground transportation in the majority of urban areas. As revenues dropped and costs increased, many privately owned mass transit companies discontinued service. Urban communities often purchased these discontinued private operations and continued them by subsidizing the service. As municipalities purchased private operations, they soon discovered that they did not have sufficient revenues to provide the services that they thought were needed. They also discovered that public ownership did not, in and of itself, solve the financial crisis.

As soon as funding from the federal government was available for public transportation, there was a rapid increase in the number of publicly owned transit systems and thus a rapid decline in privately owned systems. Many local governments felt that, if federal moneys could be brought in to purchase new equipment to replace the old or worn-out rolling stock, or if federal moneys were available to purchase additional equipment to expand service, many of their problems with public transportation would be solved. However, the local communities found that this was not the case. Large operating subsidies were required to keep the systems operating. Thus, the local governments often found that the evaluation procedures used to establish, to continue, or to expand local public transportation had led to a large increase in local funds to support public transportation. As the amount of local funds required increased, ridership decreased. Public ownership, new equipment, and/or expanded service did not, in or of themselves, cause an increase in ridership.

The local governments began to take one of three approaches to solving the operating deficit problem. One approach was to attempt to seek new ways to increase the service and thus, it was hoped, increase ridership. The second approach was to decrease services, thereby curtailing expenditures. The third approach was to return to the federal government and request that operating subsidies be provided in addition to the capital grant subsidies. None of the three approaches has been successful to date.

As the federal government became deeply involved in funding multimillion-dollar urban mass transit projects, little attention seemed to be given to developing methodologies for evaluating public transportation services. In the past, local governments were not concerned with evaluation. Because for many years public transportation systems had been primarily in the private sector, the local governments were not concerned with their operations as long as they adhered to governing regulations. The main criterion for evaluation was that established by the private sector—that is, economic viability.

There were minor attempts to establish broad uniform guidelines in planning public transportation systems, but no uniform standards were universally adopted from one system to another. Each system was evaluated by its benefits—if they could be defined. As various systems became unprofitable and public ownership became the trend, economic viability could no longer be used as the sole criterion for evaluation. If it was used, most systems were unsuccessful. If economic viability cannot be used as a criterion for evaluation, then other means must be developed to evaluate public transportation.

With the increasing trend toward public ownership and the use of public funds for subsidies, it is time that evaluation procedures be established for current operating systems as well as proposed systems. A meaningful evaluation of public transportation must occur at all levels of government.

This conference was organized specifically to identify steps required to give direction to the urban public transportation planning process, increase its effectiveness, and develop methods for evaluating public transportation. Invitations were intentionally sent to individuals with widely differing backgrounds and responsibilities. Planners, federal and state grantors, bus and taxi operators, transit authority members, and policy-makers were invited. In addition to the balance between functional areas, every effort was made to balance the professional background by including engineers, planners, managers, marketers, and social scientists.

The first day of the conference, speakers presented the perspectives and needs of transit authority boards, planners, operators, and grantors. The conference then divided into six workshops to seek approaches for giving direction to the urban public transportation planning process, increasing its effectiveness, and developing methods for evaluating public transportation. Each workshop was provided with a list of questions to demonstrate specific problem areas that are especially acute to each of the areas. The objectives of the conference were

1. To provide all attendees with a better understanding of the perspectives and needs of the users, transit authority boards, planners, operators, and grantors;
2. To identify current approaches being used by each of these groups to evaluate performance;

3. To identify steps that need to be taken to provide information necessary to plan, design, operate, finance, and effectively evaluate public transportation; and
4. To identify research projects, complete with work statements, that are needed to increase the effectiveness of each of the groups as they interact to fulfill their respective roles.

Part II
OVERVIEW PAPERS

EFFECTIVE TRANSIT POLICY-MAKING AT THE LOCAL LEVEL

Frank W. Davis, Jr., Department of Marketing and Transportation, University of Tennessee, and Member, Knoxville Transit Authority Board

THE purpose of this conference is to identify the criteria that we as an industry believe ought to be used for evaluating public transportation. We have, of course, already substantially changed our approach toward evaluation. In 1964, when UMTA funds first became available, we were convinced that it was only a matter of a few years until federal seed money for new equipment and sophisticated planning studies would bring urban travelers back onto the buses and rail services in droves so that deficits could be eliminated. As ridership continued to decline, however, we began to direct our attention to the social responsibility toward the captive rider as being much more important than total ridership. As deficits continued to grow, we even began to compare transit with libraries, schools, social security, and public highways and to say that it is only logical to expect that not only capital costs but also operating deficits should be covered by public funds.

Without ridership and cost standards that can be used to evaluate our activities, however, we as an industry are in the very difficult position of not knowing how to justify our activities or how to respond convincingly to criticism that has appeared in recent popular magazines. We do not restore public support by simply indicating that we "learned a lot at Morgantown".

This conference has been designed to stimulate thinking and to set the direction that we as an industry feel should be followed. Speakers have been selected to present different perspectives, and they have been asked to generate controversy and to challenge firmly entrenched concepts and accepted standards. We expect the speakers to act as gadflies who sting us into reevaluating our current thinking.

Participants will be separated into small workshops to discuss the ideas presented here. Participants have been assigned to workshops with people of different backgrounds, interests, and perspectives and are asked to determine the steps that are necessary to evaluate effectively the performance of our industry. Because our time is limited, even this very knowledgeable group will not have time to completely develop new evaluation measures. Consequently, the workshop chairmen have been instructed to identify each of the areas that appear promising and to specifically define the way that each of these areas should be investigated. These then become the basic research statements that will serve as guidance for future research in this area. Hence the knowledge of this group can be used to define and direct future research.

The workshops have been segmented by perspective, since each level of decision-making has different perspectives and evaluation needs. The workshop chairmen have a list of questions to start the discussion and to ensure that the need of each level of decision-making is considered. Each participant has voiced concern about the direction that UMTA, public transportation, or research is taking. We are now assembled to set the direction that it should take.

Leaving this charge for a moment, I would now like to discuss the role of the frequently maligned Transit Authority Board and the informational needs for effective decision-making at this level. Many people do not understand the role of the Transit Authority Board. The Transit Authority Board has two major responsibilities:

1. It serves as the focal point of citizen input to the urban public transportation planning process; and
2. It is responsible for seeing that an adequate level of public transportation

service is provided to the community.

The first responsibility is similar to the public hearing process as conducted by the facility planners. Unlike a facility plan, however, transit management does not have one plan to which public reaction is needed but a constant stream of decisions each week to which citizen reaction is needed. Consequently, a citizen advisory board is selected to receive citizen petitions, to gather citizen response, and to react to management and planning proposals on a continual basis.

The second responsibility is to provide the level of service that in the opinion of the authority is needed by the urban area and that the urban area can afford. The authority can accomplish this objective in four ways:

1. By using a publicly owned and publicly operated service;
2. By using a publicly owned and contractually operated service;
3. By using a contractually owned and contractually operated service; or
4. By using a privately owned and operated but publicly regulated service.

In many of the larger cities the transit systems are publicly owned and operated, and in some cases the Transit Authority Boards have lost their citizen orientation as the board members have become permanent full-time administrators. In these cases it may no longer function as an authority but as a permanent bureau or department of local government.

In many medium-sized urban areas, the systems are publicly owned because of the availability of federal grants but are contractually operated by a management company because the city had no talent or expertise available or because it wants to avoid the unionization of city employees. The contractual service option is frequently used by school systems, which annually negotiate contracts for bus service with many different firms. Social service agencies frequently contract for special trips in this manner. In the last case the authority becomes the regulatory agency in the urban area, just as the Public Service Commission is for intrastate service and the ICC is for interstate service. Typically, taxis, airport limousine service, commuter bus service, and various other types of carriage are provided in this way. The Transit Authority has four means of financing the service provided:

1. From proceeds of the farebox;
2. Through issuing bonds (generally revenue bonds for the purchase of capital equipment, which are expected to be repaid from farebox or tax receipts);
3. From local tax funds (which may come from the local operating budget or from special tax levies earmarked for public transportation); and
4. From state and federal grants.

Unfortunately, some Transit Authority Boards, like some regulatory agencies, have viewed their responsibilities very narrowly to include only the protection and furtherance of existing transit systems instead of examining the two major issues to which Transit Authority Boards should address themselves:

1. Is the service currently being provided the service that actually meets the needs of the community?
2. Is the desired service being provided in the best way?

In the first case the Authority Board is operating in its capacity as the focus of citizen input into the urban transportation process. In the second case it is evaluating the effectiveness with which public resources are being used to accomplish the public's goals.

Although these points may sound quite obvious, let me cite evidence indicating that the Knoxville Transit Authority, of which I am a member, has not done the job as effectively as it should have.

The KTA purchased the local transit system in 1968. Since that time ridership has

declined by 13 percent (Figure 1) and the cost of operation has increased from a \$202,000 operating profit to a \$635,000 projected deficit for 1974 (Figure 2). On a per-rider basis, this means that Knoxville has gone from a 4.7 cents/passenger operating profit to a 17 cents/passenger projected deficit for this year (Figure 3). We were convinced, therefore, that ridership and operating costs were not valid evaluation measures for the Knoxville Transit System. Although we would receive petitions for service extensions every month, very few service extensions proved successful on a trial basis. When we began surveying firms for potential car-pool programs, however, we found that 68 percent of the workers wanted express work buses. On a trial basis to both high- and low-income areas, approximately two-thirds of the workers making those trips switched to the buses when they were offered and were willing to pay almost twice the regular fare. We then experimented with midmorning senior-citizen specials that put together a package of movie, trip to the bank, cafeteria, and shopping and received an overwhelming response. None of these services has a national significance, but they do raise the question as to whether we have been offering the service actually desired by the public or are merely continuing to offer the same 1945 service that was rejected by the community when the system was privately owned. In addition, the growth of taxi ridership compared with declining transit ridership also indicates that we as a Transit Authority may have been more interested in nostalgically preserving traditional transit than in providing public transportation service.

At first I felt that this experience was peculiar to Knoxville, but an examination of public transportation in Davenport, Iowa, revealed a similar pattern. In Davenport the traditional transit ridership has declined by 45 percent in the last 5 years. The shared-ride taxi service during the same period has been growing by 138 percent, and now the taxi company hauls more than half as many people as the transit system (Table 1). Both the taxi and the transit system appeal to the same basic market segments, and the taxi rider pays the full cost of the ride because the operation is not subsidized or exempt from user charges. Unfortunately, many Transit Authority Boards may view this high taxi acceptance rate as threatening to traditional transit systems and attempt to levy restrictive regulations on the taxis to curb the competition. What is needed, however, are better techniques for evaluating each of the services offered to determine what levels and types of services are actually desired by the community instead of blindly promoting one type of service simply because it is traditional.

The Knoxville Transit Authority also found that it had not been evaluating the manner in which it was providing service to the community. The board had been directing virtually all of its efforts toward administering the contract with the management firm instead of evaluating the effectiveness of providing service in alternative ways. Again the car- and bus-pool program that the city has implemented revealed this. The surveys of Levi Strauss and Tennessee Valley Authority identified eight runs that could be made with five buses on express-type service. These five buses were started and completely covered operating costs from day one. At the next meeting we had requests for five more. The manager of the bus transit management company indicated that he could not provide these buses at that cost since he would have to hire new drivers to operate the vehicles and guarantee them 48 hours per week just to make a morning and evening express run. Under these conditions we would have to increase fares by 20 percent or subsidize each rider by approximately 20 cents apiece. Various alternatives were suggested:

1. Go to part-time labor so the drivers are paid only for the time worked.
2. Use selective selling; i.e., abandon fixed routes and offer express service to a plant for the 7 a.m. shift, to the professional area at 8 a.m., to the downtown shops at 9 and the shopping centers at 10.
3. Promote alternative forms of peak-hour service—car pools, taxis, contract carriage using private vehicles, intrastate bus companies, employer work buses, church buses, jitneys, etc.
4. Reduce non-peak service such as on Saturday or Sunday; this would free drivers for peak-hour service and would allow off-peak service to be contracted to taxis or

Figure 1. Ridership trend on Knoxville transit system.

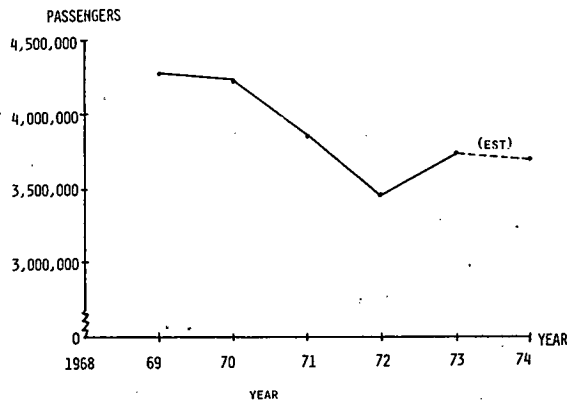


Figure 2. Knoxville Transit Authority operating deficit.

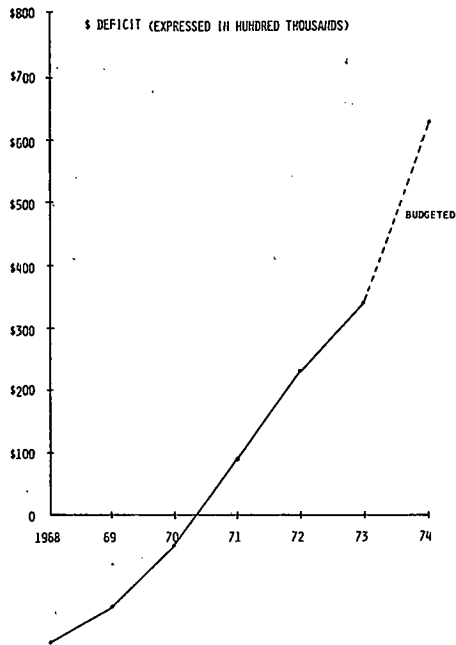


Figure 3. Knoxville Transit Authority deficit per rider.

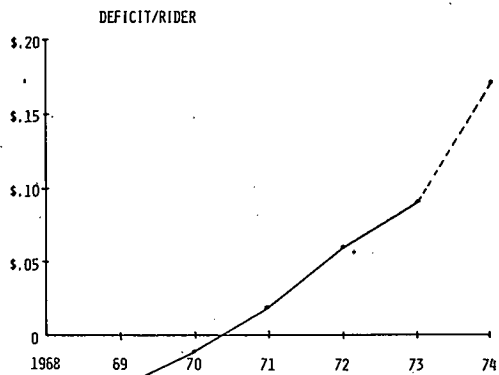


Table 1. Traditional transit versus shared-ride taxi ridership, Davenport, Iowa.

Mode	1968	1972	Percent Change
Traditional transit	1,326,895	734,176	-45
Shared-ride taxi	203,157	485,246	+138
Taxi as percent of transit	15	66	

other private companies who can operate at less than half the cost of operating the buses.

5. Take no action and thus encourage greater use of private automobiles.

Each of these alternatives is fraught with special-interest pressures. Labor unions are adamant against part-time drivers, and work rules make selective selling difficult. The transit management firm points out that their contract protects them from competition from alternative forms of peak-hour service and gives them the exclusive right to provide all service in the urban area. Although there appears to be substantial demand for peak-hour express service, the Transit Authority is faced with many institutional barriers and special interests unless we provide the service in a most inefficient and wasteful manner or do not provide express commuter service at all. The federal grant program compounds this problem by providing grants for publically owned, traditional transit systems utilizing full-time labor.

As a citizen who is a member of a Transit Authority Board, I am asking you to provide evaluation measures that will help me determine whether we are providing the service desired and needed by our community and whether we are providing the service in the most effective way.

I know that you did not come to this conference to solve Knoxville's problems alone, but I am convinced that other transit authorities throughout the country have similar problems and have not thoroughly evaluated the options available to them. Research needs to be conducted because, if transit authorities are ineffective, unimaginative, or overly restrictive in setting policy, it is difficult to have viable, effective public transportation.

If urban public transportation is to become more user-oriented, the Transit Authority Board must initiate and promote the change. Existing transit operators will only implement changes that benefit their company. As long as deficits are acceptable or are covered by federal operating subsidies, there is no reason for labor to change work rules. Likewise, transportation planners design systems to meet the needs of their clients, and if the Transit Authority Board is reluctant to outline these goals forcefully then the existing transit supplier becomes the client. Unfortunately, change will come slowly from the Transit Authority Boards, since many are reluctant to address the major issues because they feel that they are not "professionals". But in many cases the Transit Authority Board members are professionals in banking, business, or other areas. They feel that public transit is a different type of business that they do not understand, instead of simply another make or buy decision with which they are so familiar. Once they realize that there are many ways in which transportation service can be obtained for the community, they will begin to evaluate each of these as "arm's length" transactions, and the mystery of public transportation becomes much more understandable.

In summary, our charge is to develop effective evaluation measures by which our industry can gauge its effectiveness and efficient use of public funds. We must be careful, however, to openly develop means of evaluating various combinations of public transportation and not simply to develop measures to justify our current activities and vested interests.

A PLANNING PERSPECTIVE ON EVALUATING URBAN PUBLIC TRANSPORTATION

Kenneth W. Heathington, Transportation Research Center, University of Tennessee

TRADITIONALLY, the major emphasis of urban transportation planning has been on the planning and design of facilities. These facilities include all types of highways, such as local collector streets, arterials, expressways, and the Interstate System. Admittedly, urban transportation planning incorporated transit planning to some degree. However, transit planning was not a major emphasis in the majority of urban transportation studies. The major planning emphasis has been placed on the movement of automobiles within urban areas.

This highway orientation prevailed perhaps because public transportation was mainly in the private sector until only recently. Highway departments simply did not have substantial responsibilities for transit planning. There were, of course, a few public transportation systems in the public sector for many years, such as the Chicago Transit Authority. However, this was not the general pattern of operation throughout the United States. In the 1960s, public transportation began to shift from the private sector into the public sector. State highway departments began to convert into departments of transportation. These new departments of transportation have been given the responsibility for planning transportation systems for all modes. In some cases former highway planners are now required to plan for transit operations.

One of the basic questions that must be answered is whether the techniques of planning that have traditionally been used in highway facility planning can be applied to transit planning. It would seem that there is a substantial difference between a public transportation system and a highway system, and thus the methods of planning and evaluation will be different for the two modes of operation. Public transportation seems to be more clearly aligned with the principles of business than with the principles of highway facilities. If that is the case, the method of evaluation will, of course, be quite different.

Some of the basic differences, as viewed by the author, between highway and transit planning will be illustrated. It is believed that these differences must be recognized and accounted for if successful public transportation operations are to be achieved in the majority of urban areas.

SOME BASIC DIFFERENCES IN HIGHWAY AND TRANSIT PLANNING

The differences between highway and transit planning highlighted in this presentation are not intended to be all-inclusive. It is readily recognized that many more differences could be illustrated. However, if the differences shown here could be adequately accounted for, much improvement could be made in the planning of public transportation systems.

1. Highway planning is facility-oriented. Traditionally, highway planning has been oriented toward the planning and design of a facility. The objectives for that facility generally have been well defined and the levels of service to be used for the design have been established. A decision was made early in the planning process as to whether a particular facility would be an arterial street, an expressway, an Interstate, or whatever, so appropriate standards could be applied to its design. In the planning it was readily accepted that the facility could not change its location once it was built, would not be subject to shutdowns by labor, and would not be subject to many of the

constraints that apply to transit operations. The planning for a facility that is fixed and immovable is relatively straightforward. There have been adequate standards established that can be applied to the design of almost any facility. The problems encountered with the operations of a facility generally result from a lessening of the design standards in the final plan because of a compromise that has been made. The problems generally do not result from purely inadequate design.

Transit is not a fixed facility. It can and should change. The objectives for a transit system may change over a brief period of time. The demands made on the transit system by politicians, users, etc., quite frequently vary. A transit property has to be more dynamic, temporally and spatially, than does a highway facility. Thus, the plan requires that flexibility be designed into the system.

2. Highway planning and design are engineering-oriented. A highway facility is generally approached with the same type of logic that is used to design a building or any other permanent facility. Certain design standards have been accepted in the field and will be applied by any engineer trained in that area. By having uniformly acceptable standards, an engineer designing a controlled-access facility in the northeast would apply essentially the same standards as a designer planning a facility in the southwest. There generally has not been a need for taking into consideration different consumer preferences or behaviors relative to the design of a facility.

In the planning of a transit system, consumer preferences and behaviors must be considered. These consumer preferences and behaviors change with time and with geographical areas within the United States. The markets for transit are quite different from one part of the country to another. It is difficult to apply the same detailed design standards to all transit properties. A transit operation is simply different from a fixed facility such as a building or highway.

3. Highway planning is long-range planning-oriented. Highway planning has traditionally focused on long-range planning. One cannot plan, design, and construct a highway facility in a short period of time. The lead time is now approaching 10 years from the time a facility is conceived until the time that facility can be opened to traffic. Also, highway planning is long-range in that, once a facility is built, it is not intended that drastic changes be made in it within a short period of time. The highway facility generally will be located in the same position and have similar characteristics for a period of at least 15 to 20 years and, of course, can be there for an indefinite period.

Transit planning, with the exception of a rail facility or one operating on a dedicated right-of-way, does not require as much of a long-range orientation. Travel patterns change as well as consumer preferences. The market for a particular type of transit service may change in a period of 2 to 3 years. There should be a continual reordering of operations so that appropriate markets can be taken into account in the operation of a transit system. There are far more non-rail systems than there are rail. Thus, it would seem that the majority of transit operations are more susceptible to short-range or intermediate-range planning. Drastic changes are often made in systems in a period of 3 to 7 years. Flexibility must be a part of transit operations. An unchangeable long-range plan may be a detriment to transit rather than an asset.

4. It is generally accepted that a new highway facility cannot be attained easily. The public generally concedes that it takes several years to plan, design, and construct a highway facility. There is not a tremendous amount of pressure to construct a new facility in a period of months. However, the public does not view transit operations as being such that drastic changes could not occur almost instantly. Transit managers have to be cognizant of the fact that the public may expect a change in transit operations as a consumer might expect a business to carry a new product or offer a new service.

5. The highway planner or designer is not expected to change consumer behavior. Those professionals who have planned and designed highway facilities have been able to do so without having to change consumer behavior. In most cases there has been a sufficient demand for the facility so that attracting patronage is not an essential element of the design. In the transit field, however, it is expected that the transit system should be able to attract a substantial amount of patronage. This, of course, in many instances requires a change in consumer behavior. Thus, while the highway planner can forego such considerations, the transit planner must be fully cognizant of this requirement.

6. A continuing funding source for highways has been available. With the Highway Trust Fund and with the dedication of user taxes at the state level, a continuing funding source for highways has been available for many years. The highway planner and designer have not had to be concerned with the manner in which funds would be raised to support the construction of a facility. In general, one can say that there have been adequate funds available for most highway work. This, of course, has not been the case for transit. It is far more difficult to plan and design an operation in which the majority of expenses connected with that operation must be available from the consumer on a direct collection basis.

7. There is not a constant reevaluation of highway facilities in terms of cost or services provided. Once a highway facility has been constructed, there is not too much that can be done to make substantial changes in it. Therefore, an extensive reevaluation is generally not made of each highway facility.

In the transit area an evaluation is made at least yearly, since many transit properties operate with a financial deficit. The funds for that deficit often come from general revenue sources. Each year, as the budget for an urban municipality is prepared, funds are often included to subsidize transit operations. Each year there is a rejustification for supporting public transportation, and thus a reevaluation is made annually. One might argue that this reevaluation is not as good as it should be; however, it is at least considered on an annual basis in many instances.

8. The highway facility crosses political boundaries with minor difficulties. Generally, a highway facility has little difficulty in crossing political boundaries. A facility may cross many political boundaries and be readily accepted by each political structure. This certainly is not the case with transit. Many times each political entity attempts to provide its own transit operations without any coordination with the transit operations of other political entities. It then becomes extremely difficult for a person to travel by transit throughout the urban area. Often there are problems with the transfer of funds between operating properties over two or more political entities. This is not the case with highway facilities. The user taxes are collected from the automobile user at whatever place he makes the purchases. Operating across political boundaries is a much simpler procedure in the highway field than in the transit area.

9. Highway facilities have few regulators such as public service commissions. A highway facility generally is under the control of a local or state highway body. As such, there is no public service commission to which a facility must report or whose jurisdiction presides over a facility. In the case of a transit operation, regulations play an extensive role in the activities in which a transit operation may become engaged. Often, routes cannot be added, dropped, or modified without specific approval. Other activities such as goods movement or charter service cannot be engaged in without expressed approval. Often these approvals are extremely difficult to obtain and require long periods of time and substantial legal expenses.

10. Operational or maintenance costs are a small percentage of capital costs of highway facilities. In general, operational and maintenance costs are not a prime consideration in the planning and design of a highway facility, although this may change in the near future. It is true that maintenance costs are reviewed in terms of pavement design and certain other factors. However, these costs are such a small percentage of the total capital outlay that they are not taken into account as they are with transit. For most transit properties the capital costs are minor relative to the annual operating costs. The exceptions, of course, are PRT or rail systems. Since most bus systems are extremely labor-intensive, the annual operating costs must be given prime consideration.

11. Highway facilities are considered successful if they adequately serve the peak-period volume. Highway facilities are generally designed for peak-period volumes. Although average daily traffic is forecast, design considerations are made for peak periods. No one seems to be too concerned if there happens to be very little traffic on a highway in the off-peak periods. This is not true for transit. Transit has extremely large volumes in the peak periods but, like highways, experiences a substantial drop in the off-peak periods. Since the marginal cost of operating transit continues

to be quite high for the off-peak periods, a transit property often is not considered successful unless it is able to attract substantial riders in these off-peak periods. Transit generally serves the peak-period volumes as well as highway facilities serve peak demand. However, transit is not considered successful simply because it adequately serves the peak periods, as are highway facilities.

12. Demand forecasts for highway facilities are of secondary importance. There has been a tremendous amount of sophistication built into forecasting the demand for highway facilities. However, if one seriously analyzes the manner in which those forecasts are used, it is questionable whether the forecasts are in actuality as important as the amount of effort put into them. There are several reasons for this. First, most highway facilities generally have substantial traffic and are not lacking in demand. Second, once the forecasts are made it is many years before the facility is actually built and ridership can be recorded. There does not appear to be too much concern over the difference between the forecasts for a highway facility and volumes that are actually recorded unless the demand is much higher than that forecast. Third, once the highway is constructed, if the volume is not sufficient to justify the facility there is really nothing that can be done about it. The facility is built and it will not be reduced to accommodate a lesser demand.

In the transit field forecasts are much more critical. These forecasts are continually reviewed from the very beginning of operations. Ridership is compared almost on a daily basis. There is always concern as to whether ridership is decreasing, increasing, or being maintained at a constant level. Thus, the forecast for ridership on a transit system seems to be far more critical than for a highway facility.

13. A highway facility is available at all times for a potential user and the marginal operating costs are minor for this availability. The marginal cost for operating a highway facility for 24 hours in a day is relatively minor. A highway facility, unless there is an emergency situation, is always open to a potential user. This is not true for a transit property. Many of the transit services are only available for 12 or 18 hours per day. In a few limited areas there is 24-hour service available. The marginal cost for providing additional hours of service in the transit field is quite high.

14. In highway planning, the concept of "more of the same is better" has prevailed; i.e., four lanes are better than two and six lanes are better than four. It is recognized that the larger the highway facility the easier it is to accommodate a given volume of traffic. Often forecasts are stretched so that a little larger facility can be constructed. Some transportation planners feel that "more of the same is better" also applies to the transit field. Some argue that 20-minute headways are better than 30-minute headways, and that 10-minute headways are better than 20-minute headways. This is simply not true in its simplest form. It may be that the transit service is not meeting the consumer needs, and more of an inadequate service does not necessarily encourage a consumer to use the system.

15. A highway facility is generally not expected to be a revenue-producing agent; i.e., toll roads have not received universal acceptance. Toll roads have not received widespread application in the United States. For many years revenue from some toll roads was insufficient to retire the bonds that were issued to build the facilities. In general the revenue that produced a highway facility was derived from a trust fund and was not expected to be derived from an individual paying a fare for a specific given service. This, of course, is not true for transit. The fare box has been expected to provide a substantial portion, if not all, of the revenue required for operations and capital expenditures for transit.

16. Labor constraints generally do not apply to highway facilities. Generally, the operations of a highway are not dependent on labor contracts, negotiations, or disputes. Generally, a highway facility cannot be closed to public use because of disputes with labor. This, of course, is completely reversed in the transit field. Labor dictates a substantial portion of what management is capable of doing in the transit area and has a significant impact on operations in the transit field.

17. Mathematical models are used in highway planning as a substitution for product testing. In the highway field mathematical models are used to test the operations and performance of a facility. In the business world a given company will produce a

product and test it on the market. This is not practical in the highway field because of the cost related to the testing of many different designs. Other techniques, such as computer simulation and statistical modeling, have been used to estimate the performance of a given design. In the transit field there is a greater need for product testing. In the case of non-rail systems, product testing can be achieved without unreasonable costs.

18. Mathematical models used in highway planning are not truly behavioral in structure. The mathematical models used, whether in trip generation, distribution, assignment, or modal split, have not really been behaviorally oriented. While some would argue that there was a desire for behavioral models and that some models attempted to be behavioral in nature, a perusal of the models will indicate that few, if any, are truly behavioral in nature. With a facility that cannot readily change, such as a highway facility, one might argue that the behavioral aspects of the models may not be as important as in the transit field. However, in the transit field, where one can change the system and change the operations to meet consumer demands, it is imperative that behavioral characteristics be incorporated in the models.

19. Highway planning is not required to be market-oriented. In the planning of a highway facility, the planner is not required to be concerned with the market opportunities of the highway. In general the planner is not concerned with whether the user is a senior citizen desiring a reduced rate, a handicapped person that must have special consideration given to him, a young individual traveling without parents or any other special type of user. The highway planner is not required to examine the market opportunities and design the facility to attract a particular market.

This, of course, is completely different in the transit field. A transit operation attracts or serves particular markets. Often the transit system attempts to serve the entire population. This probably should not be done. The transit system most likely should be oriented toward defining the markets that have a good probability of being attracted. Markets that cannot be attracted to transit probably should be forgotten and expenses should not be incurred in trying to attract those markets.

20. Management of a highway facility is not considered to be critical to successful operation. The management of a highway facility has little to do with its ability to serve its users. In fact, management is not really considered in highway planning. In the case of transit, management is, perhaps, the most critical element in the operation. Inadequate management can cause the system to be completely unsuccessful. Insufficient attention has been given to management by transportation planners when planning a transit system. The same is true for grantors at the federal and state levels.

PUBLIC TRANSPORTATION AS A PUBLIC SERVICE

There are some who argue that public transportation provides a public service, much like a fire department, a police department, a parks and recreation department, or a public utility. This argument is being used to generate support for operating subsidies. If one looks at that argument closely, one finds that it is not true in many cases. Public transportation is different from a fire department, a police department, or a public utility. A fire or police department is expected to service the demand. No one expects these departments to generate demand for their services. While it does have social responsibilities, the manner in which public transportation is designed and operated makes it more closely resemble a business operation than a public service. Public transportation is expected to generate demand for its services.

There are differences between public transportation and a public utility such as electricity, gas, water, or sewage. Generally, with a public utility there is no competition. Public utilities are permitted to charge individual customer rates that make the business an economically viable one. Because there is no competition with public utilities and because there is a large forced demand for the services, one can maintain economic viability without necessarily maintaining efficiency in the system.

It is trite to say that there is a tremendous amount of competition between public

transportation and other modes of travel. Public transportation has pressure to keep fares low, thus making economic viability difficult to maintain. Public transportation is not in the same class as a public utility.

RESEARCH TO ASSIST IN EVALUATING PUBLIC TRANSPORTATION

There is a need for research to completely define the differences between transit planning and highway planning. This is absolutely essential if adequate planning is to prevail in the transit area. Methodologies must be developed that will account for differences between facility planning and transit planning. Simply establishing levels of service will not of itself solve the problems in public transportation.

There is still considerable concern about operating deficits in the transit field. It would be inconsistent to argue that these concerns with operating deficits will disappear in the immediate future. Local governments have taken one of three approaches to solving the operating deficit problem. One approach has been to increase the service and thus, it is hoped, increase ridership. A second approach has been to reduce services and thus curtail expenditures. The third approach has been to go to the federal government and request that operating subsidies be provided in addition to capital grant subsidies. None of the three approaches has been successful.

Evaluation procedures must be established that can be applied to public transportation and, at the same time, be accepted professionally and by the public at large. In the past there have been minor attempts to establish broad uniform guidelines in planning public transportation systems, but no uniform standards have been universally adopted from one system to another. Each system has been evaluated on its own merits, when they could be defined. Success generally has been defined in terms of the economic viability of a given system—not in terms of any specific goals or objectives. As various systems became unprofitable business ventures and public ownership became the trend, economic viability could no longer be used as the sole criterion for evaluation. Most systems in which it was used were unsuccessful. If one cannot use economic viability as a criterion for evaluation, then some other means must be developed to evaluate public transportation. If one chooses economic viability as the only criterion for evaluation, then the implication is that there is only one objective in public transportation, i.e., economic profit.

For a meaningful evaluation of public transportation to occur, all levels of government must (a) establish specific and quantifiable goals and objectives for public transportation; (b) select alternative means of accomplishing the objectives; (c) define the criteria that will be used to evaluate an alternative in terms of meeting the objectives; (d) firmly establish the constraints under which the objectives are to be accomplished; and (e) develop the methodologies to be used in evaluation of each alternative. Only after each proposed alternative for public transportation has been evaluated can one determine if the objectives can be attained within the constraints imposed on the system. Unless these steps are completed there can never be a meaningful evaluation of public transportation systems that are not economically viable.

Objectives

The objectives for public transportation should be specific and not general. Often one sees an objective or goal stated as "to improve public transportation". A goal or objective stated in that vague manner is absolutely meaningless and an evaluation cannot be made relative to it. If one defines an objective of public transportation as "to reduce air pollution from automobiles in a given corridor by 25 percent by a change in travel from auto to transit", one can easily evaluate the public transportation alternative as to whether it is meeting the stated objective. Objectives that can be quantified must be defined. It is readily recognized that this is a very difficult task, but nevertheless it has to be accomplished.

Areas in which objectives must be established for public transportation at all

governmental levels have been previously suggested in another paper (1). A summary of these will be made here. There are many more areas in which objectives must be established other than those listed in this presentation, but these are fundamental to the evaluation process and must be accomplished before meaningful alternatives can be established. The following questions must be addressed by all levels of government before proper objectives can be established and meaningful evaluation procedures developed. These questions are certainly not all-inclusive, but they do represent a beginning.

1. Should every city regardless of size and location have a public transportation system supported by federal funds? It would be difficult to find even a small town in the United States that did not have a road with some federal moneys in it. However, there are many cities without airport facilities or ports. The demand for facilities would seem to dictate the amount of financial assistance. It would seem that any area should be able to secure financial assistance in some form at all levels of government to assist with public transportation, if the demand for service is evident.

2. Must each area, regardless of size, sustain a public transportation system, including the subsidization of private systems? Definitely not. It should, of course, depend on local priorities.

3. What type of system should be supported by federal funds for any given size city? Should support for a PRT system be limited to only the large urban areas or should one be federally funded in Morgantown, West Virginia? Generally, every city has some highway facilities supported by federal funds. However, every city does not qualify for an Interstate highway, a controlled-access facility, or even a divided four-lane road supported by government funding. Air and water facilities are not available in every city, nor is it likely that they ever will be. It seems unreasonable at present to make every area a potential candidate for all types of public transportation systems.

4. Should every urban area, regardless of size, attempt to have the latest technology in all forms of public transportation? No. All cities do not have the latest technology in many fields, whether it be computers or sewage treatment plants. Economics dictate that many systems in many fields are beyond the reach of certain communities.

5. Can funding for some cities be limited to highway-oriented transit, i.e., bus systems? At the present time, this seems to be a reasonable objective that should be established at all levels of government.

6. From a governmental viewpoint, should public transportation have an objective of social responsibility and/or one of reducing traffic congestion and related problems? It is preferred that the objective include both terms, but especially the reduction of traffic congestion.

7. Should government funds be allocated to systems that only provide a social service to the community? If funding is required for systems that do not reduce traffic congestion and related problems, perhaps other agencies that have definite social services responsibility should be the appropriate ones to provide financial support. This concept would certainly apply at the federal and state levels of government. If meeting a social need is desirable at the local level, then it becomes acceptable for the local government to fund this transportation social need. The objective then becomes a social one rather than a transportation one, and the funding for such a system is in competition with other non-transportation programs at the local government level. The objectives can then be subject to review, through the elective process, by those who receive and pay for the services of such a system. This is not really true for the state and federal levels of government. The support should be oriented to the individual rather than system-oriented.

8. Should financial support be available for both capital and operating subsidies? Unless stronger arguments are presented than have been to date for operating subsidies, only capital funding should be available from the federal level. By permitting only this type of funding, the true priority for public transportation at the state and local levels can be determined. If the state and local levels refuse to support public transportation systems, it is certainly questionable whether the federal government

should do so. This type of funding arrangement is consistent with current highway programs in that federal moneys are not used for maintenance (i.e., operating requirements). These maintenance funds are derived from state and local revenues. The local levels of government should determine their priorities for all municipal services and allocate funds accordingly.

9. Should funding proceed from the federal level to the state level or go directly to an urban area? This is a serious question that needs to be resolved. If the state government is willing to play an active and progressive role in public transportation, it would seem appropriate for the funding to proceed through the state level of government. This allows local policy to be compatible with overall state programs in public transportation. Federal money should not be used in transportation to alienate state and local transportation agencies from one another. Considering that in the majority of cases transportation planning is a combination of state and local efforts, it seems appropriate to continue a program that would lead to systems integration.

10. Can standards be applied to determine the amount of financial participation that would equitably allocate resources? This is a very difficult task but it must be done. The longer it is delayed, the more inequitable will be the distribution of funding that takes place. These guidelines or standards would apply to management, marketing, and other activities just as much as to levels of service. These standards may not be of a traditional form.

11. Can demand for transit services be used as a guide for minimum system standards as is the case of traffic demand for highway facilities? There seems to be no logical basis by which to determine the feasibility of resource investment other than the demand for service. Only when there is a good demand for service does public transportation assist in solving transportation problems. Low ridership on extremely costly systems serves only a few useful purposes—none of which is transportation-related.

12. Should attempts be made to establish public transportation systems on a regional rather than on a political basis? Yes. Almost without exception, the more successful public transportation systems, in terms of demand for service, have been designed to operate over many political boundaries. It is extremely difficult for a single system controlled by one political division to be successful, particularly if the political division is one of a much larger urban complex.

Surely objectives at all levels of government can be developed relative to these 12 objectives. If these cannot be defined in a quantifiable manner, meaningful evaluation procedures can never be developed, and an equitable distribution of funds for public transportation will never be made.

Alternative Systems

Once the objectives are established, appropriate public transportation systems can be planned and implemented. Meaningful alternatives can be developed only after the objectives have been clearly and quantifiably established. A planner should not attempt to develop alternative public transportation systems based on implied objectives. Unless the objectives for an urban area can be clearly defined, alternatives should not be developed. Unless an urban area is willing to establish objectives, the alternatives that will be proposed will most likely not be successful. Even when objectives are well defined, there may not be an alternative that can accomplish those objectives.

Criteria to be Used in Evaluation

The highway system is evaluated according to the level of service provided to the individual motorist. This concept is difficult to use in evaluating public transportation systems. The fact that traditional public transportation is in reality mass transportation makes it difficult to measure or evaluate on an individual basis. Some new

innovations in public transportation lend themselves more to evaluation on an individual basis than do traditional systems.

As is well known, the highway field has used minimum design standards for facilities for many years. These standards were applicable to secondary, primary, controlled-access, and Interstate facilities. A given facility was evaluated to a certain extent in terms of the standards that were placed on it—the higher the standards, the more important the facility. Some argue that standards should be developed for the transit industry. It is difficult to make a direct analogy between highway design standards and standards within the transit industry; the main reason is that the design standards in the highway field are for a facility and the standards in the transit field would be for operations. If no attempt is made to apply a direct relationship between highway standards and transit standards, then it may be appropriate to argue that the general concept of standards could be beneficial to the transit industry. However, establishing standards will not be the total solution to the problems in public transportation. When considering standards in the transit field, strong attention must be given to management, marketing, etc., and not just to the daily operation. A transit system is a business, not a fixed facility.

In general, a large forecast traffic volume on a highway facility results in high design standards. With transit the reverse is true, in that the operating standards are raised to try to obtain an increase in demand. Thus, one might logically argue that any standards used in the transit industry would not necessarily be those of an operating nature but would be those that would attempt to attract patronage to the system. These standards might be applied to management and to marketing as well as to operations. There is definitely a need for research to establish the criteria or standards that can be used in the transit industry, but those who are establishing the standards must realize that there are basic differences between the design and operation of a highway facility and the design and operation of a transit property.

Constraints

There are many constraints under which public transportation systems must operate. In many instances financial resources represent only a small portion of the limiting constraints. The political constraints and/or regulations are often more detrimental to public transportation systems. Many systems, both public and private, are prohibited from providing goods movement. A given system could obtain perhaps 10 to 20 percent of its revenue from the movement of goods if it were permitted to do so. Organized labor often prohibits the introduction of new concepts to the public transportation field. The addition of the 13C Agreement to all federal grants has severely limited management, in many cases, to providing only outdated, unimaginative public transportation systems.

Constraints involving franchise and other regulations place severe restrictions on public transportation systems. In developing alternatives, various constraints must be taken into account. If an alternative is not feasible because of political, economic, or other constraints, then this alternative should be viewed in light of this knowledge. Constraints other than financial are very real in the public transportation field. Pretending that they do not exist or do not apply when developing alternatives does not improve the relationship of planning and evaluation.

Evaluation Process

If the objectives, alternatives, criteria, and constraints can be well defined, the evaluation process becomes elementary. Without these being defined, the evaluation process is an impossible task. The results of the evaluation process will show whether the alternatives can accomplish the objectives under the constraints placed on the system.

SUMMARY

This conference is attempting to define research needs to improve the evaluation process for public transportation. It is extremely important to recognize the differences between highway planning and transit planning when performing the research. It will be difficult to obtain satisfactory results by applying planning methodologies from the highway field to the transit field. A framework for quantifying objectives for public transportation must be established. In light of the differences between highway and transit planning, the objectives will undoubtedly be different. Therefore, proper procedures must be developed for quantifying these objectives. It is recognized that this is a difficult task, but it must be done. Only after the objectives have been quantified can a public transportation system be appropriately planned, designed, operated, and evaluated. This conference has the expertise and the ability to direct the research efforts toward evaluating public transportation. The evaluation of public transportation is not an impossible task. Let us proceed with the charge that is given to us.

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REFERENCE

1. Heathington, Kenneth W. Evaluation of Urban Public Transportation. Engineering Issues—Journal of Professional Activities, Proc. ASCE, Vol. 100, No. EI3, Proc. Paper 10662, July 1974, pp. 241-249.

TRANSIT ANALYSIS

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THIS conference is about control—the definition and exercise of management control.

This conference is also about institutions—institutions that have no inherent goals, no inherent set of values, no focused set of objectives.

This conference is about the control of institutions.

Control implies exercising power to channel efforts toward a goal. Whereas business requires goals in order to succeed, government requires none. Public institutions that respond to budgets and laws usually sustain themselves in a flurry of activity that masks an underlying lack of goals.

Consequently, we spend a lot of time working diligently on our tasks with a minimal understanding of our mission. We are frustrated. We want a sense of mission. We want to define goals that will be acceptable within the institutional frameworks that dominate our society. We want our transit programs to be as clearly defined as the highway program once was.

However, institutions do not breed the kind of goals that the American people fight for. In California, we do not even hear from the people who need transit the most. Our efforts to define goals are frustrating. Whatever goals we define will read fluently and well, but they will not generate broad-based support.

Even so, the absence of clear goals will not deter the experts from proceeding with the development of more controls.

This conference should help us develop a more sophisticated array of techniques for evaluating our transit needs and services—techniques that will find their way into the political decision-making process and help us make more rational decisions.

Influencing the decision-making process turns out to be a very interesting game. I am reminded of the transit expert from California who made his first trip to Washington to testify on the 1973 Federal Highway Act. When he returned to Sacramento, we all went down to have lunch at a little restaurant on the Sacramento River. One member of our group asked our expert how the Washington trip had gone. He paused for a long time. When he had finally gathered his wits, the expert said, "Well, you see that log floating down the river with all of the ants running all over it?" The log was quite near the bank, so we were actually able to see the ants on the log and we confirmed his observation. "Well," he said, "every ant on that log thinks that he is in control of the destiny of the ship. Things are just like that in Washington."

From my point of view, things are like that in Sacramento, too. We all think that we have a significant influence on a number of monumental problems. But too often we do not.

CALIFORNIA'S GOLDEN OPPORTUNITIES FOR EVALUATION

Just for the record, I would like to catalogue a few of the items I see as California problems. California's problems can help define the task of this conference. They can also help debunk a lot of technical rhetoric.

The Bay Area Rapid Transit District faces a deficit of over \$100 million in the next 5 years, and my slide rule says that the deficit may be a lot higher. BART has recently begun living under the terms of a new labor contract that will serve as a benchmark for all other labor negotiations in the transit industry. BART is still plagued by technical nightmares that will mar its performance for at least another 2 years. BART needs more money. What should we evaluate? Where should we start?

The Golden Gate Bridge Highway and Transit District controls the revenues from its own bridge. The District is facing a court challenge for having raised bridge tolls to subsidize transit service. It operates a beautiful fleet of "Cadillac-trade" buses and runs a ferry service that will ultimately be a beauty (in spite of losing tons of money). Should we intervene in the Golden Gate spending program when other transit operations in the Bay Area are facing monumental fiscal problems? What tools do we use to evaluate this autonomous District?

The San Francisco Municipal Railway is one of the most neglected properties in the country. Yet San Franciscans pour more than \$80 per year per capita into transit subsidies. What should we do about the situation in San Francisco?

The people of San Mateo County, just south of San Francisco, are thinking about organizing a transit district, upgrading the Southern Pacific commuter train, and completely ignoring proposals to extend BART into San Mateo County. What should we tell the residents of San Mateo County?

In Santa Clara County, the Public Works Director is acquiring vehicles for the county's new transit operation, which is centered around radio-controlled, medium-sized buses. The Public Works Director opposes all interference in his operation by the state and the statutorily created regional metropolitan transportation commission. In fact, the Public Works Director has been a leading advocate for excluding regional planning agencies from roles in approving transit funding. What should we be doing in terms of assessing the new transit system and in terms of this strong attack on our role?

In Sacramento, our flat, region-wide 25-cent "love-a-fare" has greatly increased patronage and flirtations. But so has the addition of new routes and buses. How can we determine how large a subsidy to provide a district when there is no basis for determining what share of the burden could be handled through the fare box and the local tax base?

In San Diego County, we have a regional master plan shaping up around the concept of four alternative futures—all geared to differing transportation strategies. How can we compare a radial-corridors plan to a multiple-centers plan?

In Orange County, public officials have identified key corridors for bus and dual-mode travel. They already have one of the most interesting mixes of public and private dial-a-ride services around. How do we evaluate their current program and funding needs in relationship to their emerging long-term grand strategies?

Finally, in Los Angeles County, the Southern California Rapid Transit District is moving ahead with plans to ask the voters to endorse the District's scheme for a \$7 billion transit system that will take all of the federal money that California might be entitled to over the next 20 years. How do you evaluate projects of that magnitude? Surely the issues involve more than technological and economic feasibility.

ROLES

After we have catalogued all of these wants, needs, and issues, we come to the fundamental question of roles. Who is to be responsible for what?

After a lot of politicking, I have come to believe that most transit decisions need to be made locally. I also think that most transit financing should be generated locally. If local decisions should be dominant, then the roles left to the state and federal governments run from complete non-involvement through system audit and evaluation. However, most state and federal officials are not as sure as I am that transit decisions belong at the local level. Therefore, I am sure that the debates about minimum service levels, functional classification, and standard-setting in general will generate a lot of work for state and federal officials over the next few years. But it is too early to guess that those efforts will help improve transit service.

Transit decisions need to be made at the neighborhood level, and the evaluation criteria must be designed to be sensitive to neighborhood characteristics. State and federal agencies should commit their major efforts to facilitating informed decision-making at the neighborhood level. That is where the customers are and that is where

the service has to be sold.

In California, we are spending a great deal of energy battling over the various roles of the transit districts, city councils, county boards of supervisors, regional planning agencies, and state officials. The battle is unproductive and divisive. It has delayed the distribution of funds in many counties for far too long. It clearly demonstrates that those in power are more concerned with the definition of power than in the facilitation of action.

This point, however, is not really so simple. The current disruptions are being caused because those who control the purse strings do not want to share them with young upstarts. Actually, California's most powerful local transportation officials may be the county road commissioners, who are reported to have very flexible programs and lots of dollars. The customers line up at the commissioner's door for handouts. What we are trying to do now is alter control over the handouts. It is understandable that the commissioners would object to this invasion of their territory.

GOALS: COMMUTER VERSUS TRANSIT-DEPENDENT

If we are having difficulty defining our roles, you can rest assured that we are also having difficulty defining operational transportation goals. We did a fascinating thing when we created California's Department of Transportation. The legislature specified that the Department, in cooperation with all regional planning agencies, was to define California's transportation goals.

Our efforts to define goals are generating a lot of fine statements that would read well in Fourth of July commemorative resolutions, but the rhetoric far exceeds our wildest hopes for commitment.

A lot of our goal rhetoric is aimed at the transit-dependent. When I sit down with transit experts, we have long, soul-searching discussions on the legitimate needs of the transit-dependent. We discuss the role of transit as social facilitator, as a sort of modern Sisyphus. But, like Sisyphus, every time we just about push the rock to the top of the hill, it gets away from us and the transit-dependent are left sitting on their doorsteps. This happens because there are no genuine organizations advocating the improvement of mobility for the transit-dependent. It is as if, in the minds of the elected officials, there are no transit-dependent constituencies.

In every meeting that I have ever attended where elected officials constituted the majority of the participants, the discussion has never focused on the needs of the transit-dependent. This oversight has not been deliberate. If I may venture a hypothesis, I would suggest that the mobility problems of the transit-dependent are so complex that an elected official simply cannot conceptualize how to deal with the issue in terms of the financial resources available. Until the transit-dependent organize in an advocacy posture, their needs will get lots of rhetoric but little action.

It is the commuter, in fact, who dominates the transit picture. His or her travel habits make it possible to concentrate all of our transit resources on commuter needs and still never saturate the market. The commuters are writing our goal statements through their patronage of our systems. But I do not believe that is a sufficient criterion for defining our goals.

What then are our transit goals, and how can we judge the relative importance of commuter versus transit-dependent services?

We need different sets of evaluation techniques for our analyses of commuter services and transit-dependent services. Because direct labor productivity is so much higher in commuter service than in transit-dependent service, I think it is important not to judge both services by the same set of evaluation criteria.

I still recall my conversations in Toronto with the fine professional staff of the Toronto Transit Commission. The Toronto professionals were visibly disturbed by how the politicians were disrupting their beautiful commuter system by making them provide costly mobility services that had reddened the balance sheets. By one set of criteria, the professionals were right. By another set of criteria, the politicians were right.

One last point on the issue of the transit-dependent. A lot of systems in California have initiated new, long, costly, and relatively unproductive commuter routes. The long-range potential market probably justifies some of those moves, but I would like us to develop evaluation techniques that will tell us how much transit-dependent service we could have purchased with those same loss-leader dollars. In other words, if we are going to subsidize the affluent suburbanite, we at least ought to be able to tell how much service those same subsidies could have purchased for the transit-dependent.

GOALS: MONUMENTS VERSUS SERVICE

Similarly, we need tools for assessing facility-versus-service alternatives. If the state and federal governments plan to carve out a significant role for themselves in transit, they almost have to advocate facility-dominated transit systems. I say this because I believe that large public works projects are the only situations in which you can really exercise control from remote power centers. I realize that Secretary Brinegar's statements appear to run counter to my philosophy, but I think his budget will ultimately vindicate my view. This budgeted facility bias worries me. As a fiscal conservative, I want to know how much service I can buy for my dollar. If the analysis shows that a facility-dominated system is advisable, fine; if not, then I do not want to be saddled with building a costly public works monument. The evaluation criteria must be suitable for clarifying issues of facilities versus service.

LOCAL OPTION

At the present time, our major tool for evaluating facility-dominated proposals is the voter. Each voter will decide if Los Angeles, or San Diego, or Orange County needs to pay out the dollars to build a fantastic technological marvel. Unfortunately, however, the voter has to contend with a federal grant program that distorts the fiscal analysis by discounting the true cost of the system.

The only saving grace in the proposed Unified Transportation Assistance Program was the fact that it offered opportunities for local communities to decide how they want to spend their transportation dollars. Why did it take so long to discover the word "option"?

LABOR COST

The issue of local option relates closely to another major factor that is going to be lurking behind every evaluation effort that comes out of this conference: labor costs.

Labor is the dominant variable cost in transit. Yet public agencies are totally incapable of negotiating productivity-oriented labor settlements. Labor costs will be the eternal Achilles heel of public transit. BART was supposed to be highly automated, but its recent labor settlement demonstrates that BART is now the industry's pacesetter in escalating labor costs.

The Unified Transportation Assistance Act proposal was sound in its emphasis on allowing individual regions to decide whether they wish to use federal dollars to underwrite the labor costs of transit. But as a Californian who expects to get back less than 50 percent of my federal fuel tax dollars this year, I am deeply concerned about the long-term drain on my state's resources that the UMTA program will foster. In all probability, California will be paying for the labor cost of running the Boston and New York transit systems until the end of time.

Labor's dominant role in transit costs makes me think that there are many situations where the private sector may be more effective at keeping a lid on total operating costs. The evaluation criteria must be sensitive enough to identify situations where the private sector should be able to provide service as effectively as government. It may be that government should put most transit operations in the hands of private operators who

could be motivated to negotiate business-like labor agreements.

This point leads to another problem. Because labor costs are the dominant variable in the transit budget, the operator's natural instinct is to eliminate those services that have unusually low use or productivity quotients. Therefore, the evaluation criteria should be designed to alert us to cutbacks that will have a severe impact on the ability of the transit-dependent to get around in the community.

Before leaving this point, I want to express a real aversion to fixed-formula funding programs that ignore the service and productivity factors in a system. The evaluation criteria should identify an array of techniques for weighing commuter-service productivity and mobility-service productivity for the purpose of generating subsidy formulas. Subsidies should reflect the ability of a transit system to serve its community; this implies a lot more than route-miles and population ratios.

INNOVATION

Innovation is the most vital component in all long-range strategies to expand transit's effectiveness. Our evaluation criteria must be designed so that they will not hamper legitimate efforts at innovation. I am thinking in terms of service innovations rather than technological innovations, but in both cases the evaluation criteria must be sensitive to the potential benefits that can accrue from innovative strategies.

SUMMARY

I have tried to touch on several difficult topics in a short time. One point should stand out above all others. It is clear that evaluation criteria will not work in the abstract; they must be tied to specific program objectives.

In California, we have a number of problems where good evaluation criteria could be of value. We need help in defining roles. We need help in judging the adequacies of existing and proposed programs. We need help in resolving the debates between facility and service strategies and between the commuter and the transit-dependent. We need help in analyzing the impact of labor costs and the role of the private sector.

We need evaluation criteria that will foster good local decisions. And finally, we need evaluation criteria that will allow people at the neighborhood level to control the institutions providing transit service. If transit fails to serve people, it serves no purpose at all.

EVALUATING PUBLIC TRANSPORTATION FOR EFFECTIVE DECISION-MAKING

F. Norman Hill, San Antonio Transit System

FROM the operator's perspective, the evaluation criteria for goals, objectives, and responsibilities must be designed to permit innovation in organization structure, facilities, operating procedures and practices, and service promotion, merchandising, and marketing.

The operator's perspective includes three major areas of concern: organization, facilities, and operations. These are described in Table 1.

Extensive material regarding standards for evaluating route potential and trial operation was presented at the Henniker conference on issues in public transportation (1). The reader should refer to that material for detailed information.

REFERENCE

1. Issues in Public Transportation. TRB Special Report 144, 1974, pp. 63-72.

Table 1. Evaluation criteria from the operator's perspective.

Area of Concern	Description
I. Organization	
A. Financial	Evaluation of financial position of the transit operation, its obligations, ownership (municipal or private), and impact of federal funding programs (capital grants, demonstration grants, and research grants, and the length of term of the grant), review of objectives and goals, and ultimate financial result
B. Management	Evaluation as to whether a straight-line organization is the most effective type of transit organization and assignment of responsibilities and authority to respective line organization positions
C. Personnel	Evaluation of personnel (bus operators, mechanics, and management) with particular importance given to intelligence, capabilities, and talents of management persons who will have full responsibility for key decisions and for providing first-class, acceptable service to the community
D. Relations	Evaluation of relations with transit interests, the city, the state, and the federal authorities and their respective programs
II. Facilities	
A. Buildings	Evaluation of serviceability and location of buildings in relation to their function for efficiency of administrative, maintenance, and operational units
B. Bus storage yard	Evaluation of location of bus storage yard with regard to point of entry of scheduled service into route structure to provide minimum deadhead mileage in relation to CBD for economy, efficiency, and effectiveness
C. Equipment and vehicles	Evaluation of requirements with regard to size of vehicles, seating capacity, maneuverability (length, width, power), schedule maintenance, and environmental aspects
III. Operations	
A. Promotion, merchandising, and marketing	Goals and program objectives to create an exciting image, a marketing program attractive to business people, shoppers, students, and special rider groups (e.g., senior citizens), a program to excite news media, public relations people, employees, and patrons
B. Routes and schedules	Thorough review of existing routing along with a study of schedule requirements and demands from which evaluation of operating standards may be made affecting regular services, special services, and chartered services; evaluation as to whether a 60-day minimum trial period will determine the acceptability and use of new services or routing or whether longer trial periods would be more practical
C. Fare structures	Evaluation of financial requirements of the operating system, with the end point being to establish the lowest practical and productive fare structure suitable to the community and the transit operation
D. Labor	Evaluation of employment standards, training, instruction, and follow-up training and instruction programs, especially with hourly paid employees

A PARATRANSIT PERSPECTIVE ON EVALUATION OF URBAN PUBLIC TRANSPORTATION

Alfred Blumstein, Carnegie-Mellon University and Peoples Cab Company of Pittsburgh

THE national urban transportation system needs much greater "mobility". The mobility needed, however, is not just the ability to move people and goods but rather the flexibility in providing forms of service that respond to the articulated needs and demands of the traveling public. Formal evaluation is not likely to do very much to improve that aspect of system mobility.

THE MARKETPLACE AS AN IMPLICIT EVALUATION MECHANISM

If there were a sufficiently responsive market environment and one that included a pricing system that internalized the costs imposed on the general public by the various transportation systems, then there would be little need for explicit evaluation. That would clearly be a preferable situation, because of the many inadequacies of the evaluation process: Evaluation tends to assume that values are homogeneous over the population because of the technical difficulties in accounting for the diverse values associated with different segments of the population. Evaluation tends to identify components of individuals' utilities and then to find some artificial functions (usually linear) with associated weights (usually constant) on each of the component measures to create a scalar score for a system. This is clearly less than a fully satisfactory way for representing what is clearly a messy distribution of highly nonlinear evaluation functions over the traveling public.

But we use it because we know of no better way when we delegate the public interest to some agency responsible for the function (e.g., in providing national defense) or where the decisions involve regulation of the general public (e.g., in operating the police and judiciary functions). Resort to such evaluation mechanisms should not be necessary in providing a service consumed directly by the public. The market mechanism provides a far more natural means by which each individual articulates his own values by the consumption choices he makes. Certainly this is a much more appropriate form of evaluation within the American context. What is needed for it to occur is a setting in which there is an opportunity for new forms of public transportation to emerge; then, the public by its consumption choices will provide the best possible evaluation. The closer we can come to an urban transportation system that uses the marketplace for implicit evaluation rather than some formal explicit evaluation mechanism, the closer that evaluation will reflect the true needs and demands of the traveling public.

The paratransit industry is particularly well situated for fostering such a market process. The industry already includes such varied participants as taxis, jitneys, gypsy cabs, limousine services, commuters who carry regular riders, and car pools. Most segments of the industry are characterized by low capital requirements and an associated ease of entry by new suppliers. This is a condition that should naturally give rise to high competition and thus high efficiency and market responsiveness.

This is in sharp contrast to providing the service by a governmental or quasi-governmental agency. Government is inherently a poor provider of service. In contrast to the commercial marketplace, the incentives that drive government agencies tend not to be those of efficiency or of responsiveness to public demand. Furthermore, when government provides a service, it tends to create and perpetuate a monopoly in providing that service, thereby inhibiting the entry of competing services and the

generation of new alternatives.

Of more visible concern recently is the degree to which governmental services have been shown to be particularly vulnerable to increasing labor demands. Their monopoly position makes a strike particularly severe in its public impact. The agencies' ability to draw on the public treasury makes them far more responsive to labor demands than a commercial supplier limited by his revenues and profitability.

Despite these inherent disadvantages, government is often used to provide services because an efficient market cannot be organized. Examples of this situation would include services related to joint needs, which people do not individually consume; such services include defense and fire services. Government also manages services that involve compulsory authority over individual citizens, as in police or correctional services. Even in such cases, however, privatization is being considered, with appropriate subcontracting of some correctional functions to private organizations.

Government also traditionally has provided services like education associated with the common interest in the development of "human capital". Government provides the service when individuals might have considerable difficulty in evaluating competing suppliers or when their individual choice may be less than fully consistent with the larger social good. Even in elementary education, however, various forms of voucher concept are being considered in order to restore more individual choice into the educational marketplace.

None of these considerations applies to urban transportation, particularly to the modes below rail transit, which involve independent vehicles of bus size or smaller operating on an existing road network. This is especially true for paratransit service, which can benefit appreciably from its commercial character. The appropriate role of government, therefore, should not be one of providing the service, but rather of regulating its provision to ensure that proper safety is maintained by all the suppliers. In addition, market regulation should be maintained to preclude monopoly control, to foster competition, and thereby to derive the efficiency benefits of the open market. Creating a regulated monopoly is entirely appropriate when there is a high capital cost of a distributed network in order to avoid the inefficiencies of redundant networks. (It would make little sense, for example, to have multiple parallel rail transit systems.) But there is little benefit to be derived from precluding competition among taxi companies, whereas the competition can provide considerable value in terms of price control and market responsiveness.

SEGMENTATION OF THE PUBLIC TRANSPORTATION MARKET

These considerations suggest that we should look to the private sector as the source from which new alternatives of public transportation service can be generated in response to the needs of the consuming public. In this context, it is useful to segment the traveling public into three fundamental groups:

1. The "transportationally disadvantaged" (i.e., the young, the old, the poor, and the handicapped) who do not have regular access to a private automobile and who must depend on public transportation to meet their travel needs. Many in this group have already adapted their life style (e.g., choice of residential location) to the availability of mass public transportation. Others can well afford to use existing or potentially available paratransit services. Some need transportation to obtain various publicly provided social services (e.g., education, health, recreation), and the provision of the transportation might then be coupled to the social service. For others in this group, income transfer mechanisms (e.g., welfare payments, negative income tax) are needed to enable them to meet their transportation needs, permitting them to trade off their consumption of transportation against their other needs (e.g., housing, recreation, clothing) in terms of their own individual utilities. In addition, various activities might be undertaken to aggregate their market demand (e.g., providing shuttle buses from remote public housing projects, organizing transportation to recreation centers) to improve their individual efficiency in transportation consumption.

2. The individual who does have ready access to a private automobile and whose travel does not involve travel to a major activity center such as transportation terminals, universities, shopping centers, and the central business district. For this group, it is very unlikely that any form of public transportation will divert them from the convenience, reliability, and relatively low marginal operating cost of the private automobile, and it is not particularly socially desirable to do so. They could probably best continue to travel by auto.

3. The large population group who drive their automobiles as commuters between home and a major activity center in the morning and return in the evening.

THE RAC/MAC GROUP AS THE PUBLIC TRANSPORTATION MARKET CHALLENGE

The rush-hour automobile commuter to a major activity center (the "RAC/MAC") group represents the fundamental challenge to the public transportation system. It is socially desirable and increasingly urgent to divert them from their individual automobiles into some higher density mode of transportation. In their individual automobiles they contribute significantly to congestion on the main commuting arteries, to air pollution, and to fuel consumption. Each of these increasingly important aspects of the quality of life in urban areas will be improved to the extent that we can divert this group from their cars. This challenge is one that both the mass transit and the paratransit industries must attack cooperatively. And it is one they must deal with through inducement and enticement, since the RAC/MAC, in contrast to the transportationally disadvantaged, has the option to continue to use his automobile rather than to leave it at home. This, then, requires a marketing approach that offers him something he finds more desirable in terms of price, reliability, convenience, cumulative travel time, or some aggregate function of these in terms of his own interests and utilities. In providing such a competing service, it is necessary to recognize that the RAC/MAC has a major and perhaps compelling interest in the provision of direct point-to-point transportation that the automobile affords. Anything less than that, as typified by current mass transportation systems that operate on fixed routes, would probably be unacceptable. And providing such point-to-point service efficiently in the low-density suburban environment where the RAC/MAC lives requires some involvement of the paratransit industry, at least for collection and distribution, but more likely for the entire trip.

Even within the RAC/MAC group, there is considerable diversity in terms of their divertability from their own automobiles. At the high end of the group are those who absolutely insist on continuing to use their automobiles. These might include salesmen who must carry large sample cases, wealthy individuals who can afford and insist on the privacy of an automobile (which may often be driven by a chauffeur), and others with an intense psychological need that is satisfied only by driving their own automobile. Little could be done to divert these into a higher density mode. Instead of this hard core, the target should be the marginal group who could be diverted. That diversion is possible only with a service that comes close to matching the automobile in terms of reliability, door-to-door service, time flexibility, low marginal cost (or at least a perception of low marginal cost), and no status deprivation.

Even within this marginal segment of the RAC/MAC population, the needs and opportunities are diverse. The common features shared by all such services would be a variety of ride-sharing arrangements, each of which would provide the reliable, flexible, point-to-point service that is characteristic of the private automobile. These would include multipassenger feeder and distribution extremities to link the low-density residential areas to the mass transit arteries. They would also include facilitation of voluntary organization of car pools and van pools, and, to the extent that reliability or flexibility problems inhibit these, an association with a commercial paratransit system could provide enhanced reliability by using taxis or other vehicles as a backup.

In general, then, what is needed is a much richer variety of possible ride-sharing arrangements. We might structure these arrangements in terms of the method by

which the arrangements are organized, or the "calling method"—here we might consider three variations: (a) the prearranged, regularly scheduled ride-sharing, (b) the call for a trip, and (c) hailing on the street—and the method by which payment is made—including (a) no cash exchange, (b) a fixed price, or (c) a metered fare requiring some form of computation. The various combinations of these calling and payment methods are given in Table 1. Some are the conventional arrangements conducted by private individuals or by the conventional taxi industry. Some reflect new services that should be generated by the paratransit industry, and some reflect services that could be performed better with an appropriate level of coordination.

What is most needed now is the development of a variety of new modes of paratransit services addressed at the market segments not yet receiving satisfactory service, either from the individually organized private arrangements or from the conventional taxi industry. These include, for example, services like an "occasional taxi", which would be a service provided by individual RAC/MAC commuters on their way to work. With special authorization (perhaps through a taxi franchise), an individual RAC/MAC commuter could transform his private automobile during the rush hours into a taxi carrying passengers at a reasonable price (perhaps 50 cents to \$1.00, depending on the distance involved) into his destination zone. Such a service would smooth the peak rush-hour demands on the transit industry, thereby permitting transit to operate at more efficient capacity levels (which might well be lower than its current capacity). It would also permit the individual commuter to leave his car at home with a reasonable assurance that he would find a ride to work and home again. If the commuter demand for such service exceeded the supply at any time, that would provide incentive to more individuals to function as occasional taxis. Conversely, if the supply exceeded the demand on any route, more people might thereby be encouraged to leave their cars at home and ride an occasional taxi to work.

A major hindrance to the introduction of such new services is the variety of regulatory constraints that currently inhibit extension of paratransit service. These constraints restrict entry into the market and inhibit the creation of new (especially multi-passenger) modes of paratransit service. The need for franchises and licensing implies a major front-end cost, which effectively excludes most potential suppliers. Service boundaries structured around political jurisdictions rather than demand corridors effectively limit the development of service. Regulations often specify in detail how fares must be computed, thereby requiring certain expensive equipment in the paratransit vehicle. This may preclude the use of more elaborate computing technology at a central processing unit that serves a variety of sensors and display terminals in the individual vehicles. Paratransit vehicles have a variety of cosmetic requirements, such as lights, lettering, and signs, which might inhibit individuals who would be willing to function as occasional taxis but do not want to clutter up their cars with permanent displays; perhaps a magnetically affixed and removable sign would serve that purpose.

One major constraint on the provision of paratransit service is the requirement that restricts the provision of multipassenger services to a bus company. Various forms of symbiotic relationships can be established between bus companies and the paratransit industry. These include the use of smaller paratransit vehicles along the low-density bus routes to provide more frequent service than would be efficient with

Table 1. Ride-sharing arrangements.

Calling Method	Payment Method		
	No Exchange	Fixed Price	Metered Fare
Prearranged	Car pool	Daily rider	Standing cab order
Call	Friend's pickup	Jitney	Dispatched metered cab or dial-a-ride
Hail on street	Hitchhiking	Zone-fare taxi or "occasional taxi"	Cruising taxi

regular bus operations. Also, low-density periods such as nights and weekends could be served more efficiently by a paratransit vehicle than by a bus. Such a vehicle could even provide off-route service to the destination with negligible increase in cost or time, thereby stimulating service demand on the route by improving the quality of service.

It should be clear from the simple examples discussed here that much more potential exists for extending, expanding, and improving public transportation services through the use of paratransit modes of ride-sharing. One might evaluate these in terms of conventional measures like aggregate travel time (including waiting time), air quality impacts, energy consumption, and system costs. And such pre-evaluations should be conducted prior to the introduction of new services. It can reasonably be expected that many such paratransit services would be found to provide significant improvements over existing available services. But it makes little sense to post-evaluate operating services explicitly in terms of these individual components. It makes much more sense to conduct the evaluation by letting the traveling public express its own market preferences. Thus, rather than formal evaluation, what is needed is the development of a process whereby new paratransit modes are developed and tried in the marketplace of public demand. Those that attract RAC/MAC passengers can be judged to be successful; those that fail to do so, regardless of their performance on explicit evaluation criteria, cannot be considered successful.

This requires the introduction of models of service that are fundamentally experimental. They must provide a service mix that includes regular taxis, dial-a-ride multiple-passenger taxis, and group ride-sharing arrangements like car pools and van pools. Integration of these will permit standby arrangements that provide backups to ride-sharing arrangements that are individually made.

In that experimental mode, it is necessary to test the elasticity of identifiable segments of the RAC/MAC market to the various service parameters such as price, total travel time, delay, and reliability. This requires an experimentally oriented and innovative taxi company and a cooperative government regulatory agency, both committed to this approach to innovation and service improvement. At Carnegie-Mellon University we have taken a first step in that direction by acquiring control of a previously bankrupt taxi company, the Peoples Cab Company of Pittsburgh. Using this cab company as our laboratory, we plan to conduct experiments with new paratransit service in the Pittsburgh marketplace. We hope thereby to provide some models of improved point-to-point transportation service that will appeal to this fundamental RAC/MAC constituency. Once their attractiveness has been demonstrated in our marketplace, we hope that that will lead the way for other communities to establish similar services.

Even better, we would hope that other communities will use this experimental marketplace approach, both for improving paratransit service and as a much more appropriate paradigm for evaluating public transportation services.

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Part III
WORKSHOP REPORTS

WORKSHOP 1: THE GRANTOR'S ROLE

George E. Gray, California Department of Transportation, Chairman

THESE are the transit-oriented questions grantors felt they need answered:

1. What is the appropriate distribution of transportation resources among the various transport modes?
2. What is a rational and equitable basis for allocating (and distributing) transit resources among client groups: Need? Urban considerations? Rural considerations? Elderly role? Handicapped role? Other transport-disadvantaged?
3. What are the appropriate measures of performance for transit systems: i.e., what does a grantor use to judge good and bad performance among client transit systems?
4. What are the attitudinal and motivational factors that influence transit patronage and what is the proper (ethical) use of these factors?
5. How does one design a financial aid program that appropriately encourages (rewards) service and discourages (penalizes) inefficiency and resource waste?

Can research provide answers? What research projects are needed to provide the base for such answers?

Like most groups given such a monumental task, we spent a good amount of time thrashing around, trying to decide how best to address the problem from the grantors' viewpoint. Our plan was to see—through discussion—if we were understanding, first, each other and, then, the questions identified as the major concerns of the grantors. There were problems in communication because we represented a broad spectrum and had diverse backgrounds. The learning through exposure as we proceeded with our task was interesting and one of the most productive results of the session to me and, I am sure, to many others. We were all basically involved in the same arena, but with a great variety of perspectives. Once we settled down and understood one another, we found that our basic goals were similar but our methods varied. Even with these differences it was not long before we were developing a considerable listing of possible research projects.

We had the added difficulty, as a group, of keeping our focus on the grantors' perspective. Some of us had problems playing that role, and our final results indicate the problem.

As grantors we spent considerable time on how to measure the big question, "What are we getting for our money?" This same question is high on the lists of users, taxpayers, and legislators. Perhaps we cannot measure public transportation until goals and public policy are better established. The basic need for transportation is not even agreed on. And, although transportation is ubiquitous, we do not know much about the extent of its elements. The rural and private sectors are especially unknown.

The grantor (government) has a tremendous responsibility—one it is largely trying to ignore. The energy, environmental, and political tugs-of-war are directing much of their pressures on transportation without anyone first deciding if transportation is to be used to reinforce existing life styles or be used as a tool for social change. The federal government is still trying to decide if the states have a role in public transportation!

We also considered areas where government could help the transit properties improve their services. Three general areas were identified and discussed: (a) managerial and other training programs, (b) identification of the users' relative weighing of the SCARCE factors (safety, comfort, accessibility, reliability, cost comparative, and efficiency) when making a mode choice (possibly it should be investigated based on

market segmentation), and (c) information systems—for both users and managers.

Another area of discussion was the concept of classification/levels of service/evaluation criteria. There was general agreement that measures of transit service are needed, but concern was voiced over the value or practicality of the classification concept. With our time constraints we could not fight the battle there, but we agreed this was a major research need of immediate concern as many agencies, regions, and states are furiously working to complete transportation plans that should have this input. It is already too late for input in the first iteration.

Problems of the handicapped were also discussed—the equal but not separate issue. We decided the Urban Transportation Act, as it moves through the legislative process, will shape the future in this area and we should wait. There was concern over the emerging concept that access to a basic public transportation system was a civil right.

In our first listing of possible research topics we addressed these and other items. Because time was limited we concentrated our efforts on the eight areas of our major concerns. I am sure that with a different mix of individuals or more time we would have developed different proposals, and probably none of us is completely satisfied with our results. But compromise and incremental change are the name of the game. I only hope our compromises will lead to some incremental changes.

Following are the areas of recommended research in public transportation from the grantors' perspective as developed by Workshop 1:

- 1-1. Classification of Urban Areas
- 1-2. Development of Methodologies for Assessing and Evaluating Alternative Mobility Systems in Urban Areas
- 1-3. Identification of Rural Transit Needs and Methods of Meeting These Needs
- 1-4. Public Transit Operational and Managerial Training Needs
- 1-5. Motivational Research Needs Related to Modal Choice Decisions
- 1-6. Investigation of the Feasibility of Establishing a "Transportation Broker" Through a Case Study
- 1-7. Development of Appropriate Roles for Various Levels of Government
- 1-8. Identification of Potential for Private Sector to Satisfy Public Transportation Needs

A detailed description of each research project is given in Part IV of this book. The top-ranked projects selected by this workshop were

- 1-1. Classification of Urban Areas
- 1-2. Development of Methodologies for Assessing and Evaluating Alternative Mobility Systems in Urban Areas

WORKSHOP 2: THE LOCAL POLICY-MAKER'S ROLE

James C. Echols, Tidewater Transportation Commission, Chairman

THE members of Workshop 2 felt that the priority needs for research are in the areas of (a) management of the provision of public transportation services in urban areas and (b) the evaluation of the markets for public transportation and how best to serve the markets.

Three specific research areas were explored:

1. Examination of organization forms to deliver adequate public transportation services;
2. Determination of the current market for public transportation services and evaluation of existing services to ensure that services provided are in step with demands for service; and
3. Review of the method of financing transit services that are needed or felt to be needed to meet community goals and objectives.

The members of the workshop concluded that understanding and application of improved management and administration of existing public and paratransit services would probably be adequate to produce significantly improved transportation services, rather than the development of large, new-technology systems.

Following are the research projects developed by Workshop 2:

- 2-1. Financing of Transit Service to Meet Community Goals and Objectives
- 2-2. Examination of Alternative Organizational Forms for Delivery of Public Transportation Services
- 2-3. Use of Marketing Techniques to Evaluate Transit Services
- 2-4. Relation of Transit Service Attributes and Consumer Preferences

The top-ranked projects selected by Workshop 2 were

- 2-1. Financing of Transit Service to Meet Community Goals and Objectives
- 2-2. Examination of Alternative Organizational Forms for Delivery of Public Transportation Services

WORKSHOP 3: THE PLANNER'S ROLE

Edward Weiner, U.S. Department of Transportation, Chairman

THE purpose of Workshop 3 was to determine what research is required to better evaluate public transportation from the perspective of the transportation planner. To accomplish this task, the workshop first identified the steps in the planning process and evaluated current ability to perform each of these steps in terms of available procedures and knowledge. Where current knowledge and methodology did not exist or were inadequate to perform the various steps in the planning process, a research task was identified and a research statement produced.

Next, a number of points were discussed and agreed on in determining the nature of the planning process and the rules under which it should be conducted. This was necessary so that deficiencies in the process could be identified and research needs established.

Finally, as a result of these discussions, several concerns were raised with regard to manageability of the planning process.

STEPS IN THE PLANNING PROCESS

Figure 1 shows the steps in the planning process that focus on evaluation. The process is goal-directed. General goals and more specific objectives are developed and agreed on early in the process. These are refined, with the development of specific criteria to be used to assess the ability of transportation alternatives to meet the goals and objectives.

Next, several transportation alternatives are designed to serve the urban area. These alternatives are evaluated to determine their ability to meet the goal, objective, and evaluation criteria. This step is complex and may involve sophisticated travel forecasting and impact models. Once an alternative is selected that best meets the area's goals and objectives, it is implemented.

Throughout this planning process, there should be feedbacks. For example, the types of alternatives that best meet the goals and objectives may be deemed undesirable and require revising the goals. Or the actual effects of a transportation improvement may not match the forecast effects and require changes in earlier steps in the process.

The planning process should be structured as a learning process in which new information should be fed back and the various steps in the process reassessed in light of this information.

GUIDELINES FOR THE PLANNING AND EVALUATION PROCESS

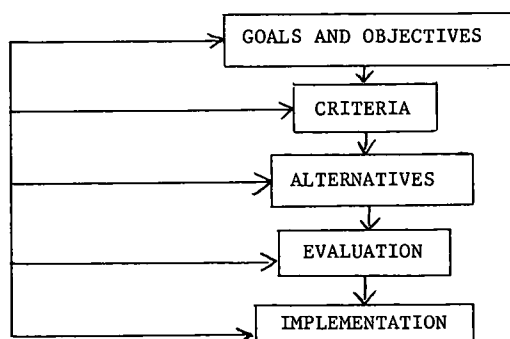
Several points were agreed on that constitute ground rules or guidelines for the planning and evaluation process. These are discussed in the following sections.

Transit Versus Transportation Planning Process

The process should be a multimodal transportation planning process, not a transit planning process. Transit cannot be evaluated meaningfully in isolation from the remainder of the transportation system. In fact, it was argued that transportation cannot be evaluated in a manner isolated from the other systems in an urban area.

This issue is of growing concern as new options and alternatives are identified. It

Figure 1. Steps in the planning process.



is becoming increasingly difficult to determine where the definition "public transportation" begins and ends. This is particularly true when the alternatives include commuter bus clubs, dial-a-ride, shared-ride taxicabs, car pools, public automobile systems, jitneys, and subscription taxicab service. This wide spectrum of alternatives requires that the planning process evaluate all transportation modes in an integrated manner rather than focus narrowly on conventional transit modes.

Participatory Process

The planning process should be an open participatory process. It should not be a mechanical process where the evaluation technique is developed in the back room and the plans are evaluated by some scoring technique where the alternative with the highest score wins. The process should be a bargaining process that involves political decision-makers, citizens, and representatives from the various interested governmental agencies. That approach results in a very different kind of process than one in which the computer determines the answer. Participation should occur during all steps of the planning process, starting with the development of goals, objectives, and evaluation criteria, through the identification and evaluation of alternatives, to implementation, and in the feedbacks all along the way.

The role of the planner in such a participatory process becomes quite complex. The primary function of the planner is to communicate to the decision-makers and the citizens the implications of the alternatives in an understandable manner. The planner should assist in goal formulation, work with the decision-makers and citizens in the design of alternatives, provide the technical skills to evaluate the alternatives, and explain the results of the evaluations in an understandable manner.

Range of Alternatives

A wider range of alternatives should be evaluated in the planning process than has traditionally occurred. The number of alternatives evaluated will be limited by practical considerations of time and cost. However, they should include a broad range of service packages and pricing options, including capital-intensive, low-capital, and no-build options.

Short-Range Versus Long-Range Planning

The planning and evaluation process should be carried out for both short-range and long-range planning horizons. Traditionally, planning has concentrated on long-term horizons to the detriment of short-range issues. Recent changes in emphasis indicate that the pendulum may be swinging too far in the other direction by just looking at tomorrow and ignoring the longer range issues. With a short-term orientation, it will be impossible to produce a long-term strategy for improving the transportation system, especially for major facility investments. What is needed is both a short-term and long-term horizon.

Staging of Long-Range Plans

One approach to resolving the dichotomy between long-range and short-range planning is to develop a long-range plan and stage it into several short-term programs. However, the danger in such an approach is that the short-term programs will not produce operational transportation systems until the entire plan is implemented. Particular care should be taken to analyze the performance of the transportation systems based on the implementation of at least the first stage (2-5 years). Implementation of this first stage should produce a viable operational transportation system that does not require elements of later stages to make it workable. This requires the inclusion of transportation improvements in this stage that balance considerations of short-term needs and goals, implementation problems, and available funds.

Multidisciplinary Team Effort

The planning process should be performed by a multidisciplinary team effort. Engineers and planners do not have a broad enough range of skills to deal effectively with the extent and complexity of issues that are being raised in the planning process. Planning is becoming an increasingly complex task, and the issues required to deal with it are broadening beyond the training and skills of the professionals who have traditionally been involved in it. It will also be necessary to learn how to organize and manage interdisciplinary groups to work together effectively and productively.

Influence of Funding Agencies

The source of implementation and planning funds should not constrain the results of the planning and evaluation process. The planning process should respond to local problems, issues, and goals. Alternatives should be developed and evaluated in a manner that best responds to these locally determined goals. Funding agencies should be involved in the planning process but should not constrain the nature of alternatives and the evaluation. This is particularly important in the current fluid situation where the roles of various agencies are being reviewed and changed and where pending legislative proposals could radically alter funding authority and amounts at all levels of government.

Size of Urban Area

The planning process should be scaled to the size of the urban area. It is possible that if small urban areas (50,000-150,000 in population) used sophisticated planning techniques and carried out a planning process as complex as those in large urban areas, they could spend more money in conducting the planning than in implementing the results. The planning process in small urban areas can evaluate a narrow range and smaller number of alternatives than large urban areas. Further, the techniques used for forecasting and evaluating alternatives need not be as sophisticated. Research should be conducted to develop simplified planning techniques to permit these smaller urban areas to perform their planning and evaluation.

Measuring the Impacts of Transportation Changes

After implementation has occurred, the impacts of transportation changes or system improvements should be continually measured. This information should be fed back through the planning process to assess the accuracy of the forecast and to evaluate whether the impacts are those that are desired by the urban area. The assessment of these transportation improvements should affect earlier steps in the planning

process and could even affect the goals and objectives established at the beginning of the process.

National Transit Performance Standards

Standards are specific values of criteria, either maximum or minimum values, that represent a desirable level to be achieved. These standards cannot be established without knowledge of the goals or objectives to be achieved. Performance standards are meaningless in isolation without relating them to goals and objectives of an urban area. It was previously agreed that goals and objectives should be locally determined. As a consequence, performance standards should also be locally determined. Even if national goals and objectives could be identified and agreed on, they would not apply equally to all urban areas. Further, they would not cover all concerns of specific urban areas, and thus each area would still be required to develop its own set of goals and objectives.

Although in general there are no national performance standards, there are several areas in which national standards could be developed. These include safety, environment, and possibly security. Further research on this issue may yield national standards in other areas.

Concerns About the Planning Process

The discussion of the steps in and the guidelines for the planning process raised several concerns. First, it is not clear whether the task of making trade-offs among the wide range of issues in the planning process is manageable. Trade-offs must be made—among goals, among evaluation criteria within goals, among the wide range of alternatives, and between short-range and long-range problems and issues. Each of these adds a dimension of complexity to the planning process. Planners will have to make as many of these trade-offs as possible within the practical constraints of time, cost, manpower, available techniques, and guidance of the participants in the process.

Second, as the planning process grows, the growing complexity of the planning process in terms of the number of alternatives and impacts that should be considered and the number and heterogeneity of participants in the process will consume more time and money. It will also require large staffs with a wider range of expertise. Planning for smaller urban areas is of particular concern in this regard.

Third, as the complexity of the planning process increases, so does the difficulty of communicating the issues, alternatives, and impacts to citizens and decision-makers. This problem could jeopardize the credibility and effectiveness of the process.

Research Needs

Research needs and project statements were derived from a discussion of the structure and content of the planning process and evaluation of the ability of current methodology to perform the various steps in the process in a satisfactory manner. Where deficiencies were identified in methodology or current understanding, research statements were prepared.

The following research projects were developed by Workshop 3; they are listed in the order of the steps in the planning process.

I. Overall Planning Process

- 3-1. Development of a Participatory Multimode Transportation Planning Process
- 3-8. Evaluation of Alternative Institutional Structures and Agency Responsibilities for Transportation Planning

II. Goals and Objectives

- 3-4. Deriving Goals and Objectives for Transportation in Urban Areas

III. Criteria

- 3-2. Matching Transportation System Criteria to Transportation Goals

IV. Alternatives

- 3-5. Methodology to Match Transportation Modes to Different Markets
- 3-7. Techniques for Segmenting the Public Transit Market
- 3-11. Manual of Performance and Operating Characteristics of Transit Modes

V. Evaluation

- 3-3. Identification and Measurement of Transportation System Costs and Benefits
- 3-6. Transit and Paratransit Forecasting Techniques
- 3-9. Sketch Planning Techniques for Low-Capital Alternatives
- 3-10. Methodology for Measuring Transportation Impacts on Land Use

VI. Implementation

- 3-12. Determination of the Length of Time Required for Transportation Impacts to Occur

A detailed description of each research project is given in Part IV of this book. The top-ranked projects selected by this workshop were

- 3-1. Development of a Participatory Multimode Transportation Planning Process
- 3-3. Identification and Measurement of Transportation System Costs and Benefits

WORKSHOP 4: THE OPERATOR'S ROLE

John B. Schnell, American Public Transit Association, Chairman

THE purpose of Workshop 4 was to determine what research would best fulfill the needs of the transit industry from the operator's perspective to better evaluate public transportation.

Workshop 4 divided the task into 5 basic subject areas and, after considerable discussion, generated a list of 29 research topics, divided as follows:

1. The elderly and the handicapped:	8
2. Manpower:	7
3. Hardware and equipment:	3
4. Financial:	4
5. Marketing and management:	<u>7</u>
Total	29

From these 29 research topics we selected 9 that we felt were most important; for these we prepared research statements and proposals.

Following are some of the reasons the ranking process was so difficult for the members of this workshop:

1. Some members of the workshop realized that certain research was either currently being pursued or likely to be begun in areas that would probably preclude the need to pursue some of the research projects, at least in their entirety.

2. Some of the projects were extremely narrow but quite important and lent themselves to being accomplished in a relatively short period of time with a small amount of funding. It appeared to some members of the workshop that these projects had a much better chance of being accomplished and the probability of their having an effect on transit in the near future was reasonable.

3. Others in our list of research statements encompassed a broad subject area and might be so comprehensive that a complete and definitive answer might be difficult if not impossible to obtain. Thus, regardless of the importance of some of these broad basic subjects, there was a question as to how much would be accomplished by a potentially expensive, long-range research project.

4. Another question raised was, "What would be done with the rankings we might provide?" If we had an opportunity to refine more thoroughly the project statements initially prepared and to study all of them, our opinions might change as to which were the most important.

Following are the research projects developed by Workshop 4:

- 4-1. Planning and Design of Mass Transportation Services to Meet Mobility Needs of the Elderly and Handicapped
- 4-2. Study of the Merits and Problems of Combining Some Transit, School Transportation, and Goods Movement With Transit Vehicles
- 4-3. Evaluation of the Purchase of New Transit Vehicles via the Consideration of New-Vehicle Quality as Measured Through Vehicle Maintenance Costs
- 4-4. Effectiveness of Federal and/or State Operating Subsidies for Urban Public Transportation
- 4-5. Development of Effective Marketing Disciplines for Promotion of Use of Club Buses, Subscription Bus Service, Special Charter Group Trips, etc.
- 4-6. Effect of Car Pool Promotions on Transit

- 4-7. Evaluation of Fare Packaging Procedures as a Tool for Inducing Transit Ridership and Reducing the Cost Associated With the Sale and Collection of Tickets
- 4-8. Use of Retired and Part-Time Personnel as Transit Employees
- 4-9. Human Resource and Development Needs for Expanding Transit Services

A detailed description of each research project is given in Part IV of this book. The top-ranked projects selected by this workshop were

- 4-7. Evaluation of Fare Packaging Procedures as a Tool for Inducing Transit Ridership and Reducing the Cost Associated With the Sale and Collection of Tickets
- 4-3. Evaluation of the Purchase of New Transit Vehicles via the Consideration of New-Vehicle Quality as Measured Through Vehicle Maintenance Costs

WORKSHOP 5: THE USER'S PERSPECTIVE

William T. Olsen, Florida State University, Chairman

THIS workshop had perhaps the most sharply focused of all the workshop topics in that it dealt specifically with the user's perspective. The acknowledged importance of this perspective was amply demonstrated during the conference by the various workshops dealing with the grantor's role, the policy-maker's role, the planner's role, and the operator's role, each emphasizing a focus on understanding and meeting consumer needs in addition to the other relevant dimensions of their respective viewpoints. Because this conference was designed for the purpose of identifying research needs for evaluating public transportation, it is apparent that a consumer orientation represents a newly emerging approach to transportation planning and evaluation that suffers at present from substantial knowledge gaps. The writings of Orski, Tomazinis, and Webber serve to illustrate the basic issues involved and the need for increased emphasis on consumer perspectives and broad community goals in the planning, design, and evaluation of public transportation systems.

Orski has presented some conclusions reached at an international meeting of the Organization for Economic Cooperation and Development in Paris (1). He states that the new conceptual approach to transportation planning is one giving increased emphasis to human values as well as the social and economic goals of the urban development. Engineering and economic efficiency no longer serves as the only guiding principle for transportation investment decisions. Instead, these technical factors must be weighed against the social, economic, environmental, and aesthetic needs of urban residents, including those of personal mobility, accessibility to urban opportunities, comfort and convenience, clean air, pleasant surroundings, preservation of neighborhoods, and urban diversity.

Implicit in Orski's statement is the acknowledgment that transportation is not an end in itself but serves as a means to a set of desirable social ends. The basic objective of transportation system investment, therefore, is not just to move people but to improve the social well-being of an area's residents.

The role of public transportation in facilitating the provision of essential social services was stated by Tomazinis in 1971 (2). Tomazinis depicted mass transit as constituting a social service delivery system wherein economy and efficiency of operation were relevant only with respect to the way that reasonable transportation alternatives were provided to meet more basic social needs of all population groups. To provide for the social service needs of these various groups, the administration and decision-making processes within the system were said to require substantial inputs from a broad constituency, including community leaders, technical experts, and consumers.

Taking an approach similar to those of the two previous authors, Webber (3) cited three reasons for the inadequacies of existing methods of transportation system evaluation:

1. Transportation investments were viewed primarily as capital investments in physical facilities rather than as investments in transport services.
2. The function of transportation facilities was seen as connecting geographic places rather than connecting people with essential social service opportunities.
3. The primary test of transportation system appropriateness was least cost rather than the largest output of benefits.

The widely shared acceptance of these attitudes toward transportation system planning and evaluation has led transportation planners to operate as though social value is a characteristic residing within the facilities themselves. The conflict, as Webber

states it, is that we know that the real utility of transportation derives from improved linkages between buyers and sellers, recreation consumers and recreation resources, community services and people who require those services, employers and employees, etc. Yet, when the merits of public transportation services have been appraised, we have seen criteria applied that dealt solely with narrow performance measures (e.g., travel time, departure frequency, schedule reliability) of the transportation facilities themselves.

As a simple means of overcoming this narrow focus, Webber suggests that we reconceptualize the nature of a transportation system by viewing it as a dynamic community service rather than as an inanimate facility. The relevant questions in transportation system evaluation then become: What socially desirable services does the system provide? Which groups of people are able to take advantage of these services? What are the consequences of this service delivery?

More importantly, in identifying the shortcomings of existing transportation systems and developing more socially responsive systems of the future, we can then ask: What social service linkages should be provided to meet various consumer needs?

The user's perspective workshop addressed many of these issues during the conference. Among the disciplines and professions represented by the workshop participants were engineers, planners, social scientists, transit operators, university professors, consultants, and professional staff members of transportation agencies. This diversity of workshop composition served to bring out many conflicting viewpoints during the discussion meetings.

The major issue that emerged in the workshop involved the identification of appropriate dimensions of consumer satisfaction and ways to measure the responsiveness of transportation service to consumer requirements. Two basic viewpoints were expressed.

One viewpoint dealt almost exclusively with transportation system attributes. Transportation service quality was expressed in terms of variables such as fare, number of transfers, travel time, walking distance, ride comfort, and schedule reliability. Public transportation users were included in this viewpoint in terms of the amount of travel they would consume given the status of these transportation system attributes. In other words, travel demand is the definitive measure of the degree to which transportation services meet user needs. High levels of transit ridership thus serve to indicate acceptable levels of transportation service. Low ridership, on the other hand, is an indicator of undesirable transit system attributes from the user's perspective. Under this viewpoint, research needs involve topics such as how to measure elasticities of travel demand with respect to the transit system attributes, how to identify different degrees of demand elasticity among various types of users, and how to identify those transportation service improvements that will cause the greatest diversion of travel consumers from the auto mode to a transit mode.

The second viewpoint expressed the need to regard transportation as a linkage between people and activities. Because there is no inherent value to consumers in transportation system attributes themselves, the evaluation of public transportation service to a community would be improved by consideration of the consequences of transportation linkages (or their absence) on the lives of community residents. This viewpoint takes the position that travel demand as measured by actual ridership does not adequately measure community service—nor does it guarantee that all segments of the community are equitably served. Users and potential users are characterized by their basic needs and desires, their physical and economic resources for satisfying these needs, and their tastes and preferences regarding acceptable transportation alternatives.

Both of the viewpoints expressed have their respective merits. The second viewpoint has the virtue of being closer to the essential nature of transportation linkages to community residents, whereas the first viewpoint embodies the set of choice variables actually available to transportation professionals in planning, designing, and operating public transportation systems. Obviously there is a great research need to effectively translate social, economic, political, and environmental community objectives into transportation service objectives that have significance and are attainable

by transit planners, designers, and operators. In recognition of this, the user's perspective workshop combined both viewpoints in many of the research project statements and identified topics to specifically deal with the issues of translation of community objectives into meaningful information for transit professionals as well as the translation of transportation system characteristics into meaningful information for community decision-makers.

Substantial agreement among the workshop participants was found in the discussion of user identification and information requirements for system evaluation. It was concluded that people cannot be simply categorized as either users or nonusers of public transportation. Instead, as people's personal characteristics and circumstances vary, so do their transportation requirements. In the past, the identification and subsequent treatment of users has been limited to labels such as "riders" or "fares", with little regard to their individual needs. Because of this narrow view of transit consumers, transit systems have developed with barriers sufficient to preclude their effective utilization by some groups of potential consumers (4) and have succeeded in providing high-quality service only to employees with work trip destinations in central business districts. Recent legislative action such as Section 16A of the Urban Mass Transportation Act and Section 301(b) of the 1973 Federal Aid Highway Act indicate increased concern for providing public transportation services that can be effectively used by such heretofore unrecognized groups as the elderly and handicapped.

The second area of substantial agreement, perhaps conditioned by the theme of the conference, was the recognition of the inadequacy of present techniques of transportation system evaluation. Each of the conference workshops expressed the need for greater levels of detail concerning transportation system consequences as evaluation and decision-making inputs. A research topic proposed by the workshop carried this point further by recognizing that evaluations of proposed transportation improvements are made on the basis of their anticipated consequences. Because of the numerous errors of measurements, specification, and forecasting that are introduced in this process, there is no assurance that the anticipated consequences will actually be achieved. There is an obvious need, therefore, to monitor and reevaluate the performance of such systems so that appropriate modifications can be made to ensure desirable levels of service delivery.

To conclude this summary on a personal note, I was disappointed that the conference did not give greater emphasis to the problems of the transportation-disadvantaged (i.e., the poor, the elderly, the handicapped, and others without access to a suitable transportation mode). Much of the workshop discussions centered around issues of labor problems, profitability of transit properties, and modal choice. The need for mobility and the difference it can make in the quality of people's lives is of such major importance that public transportation for those without the choice to use automobiles ought to be viewed as an essential social service rather than as a commodity in the public market. In contrast to resource allocations presently made for investments such as community health programs, which are virtually accepted as being essential, public transportation still is required to prove its merits (unfortunately solely in terms of user payments versus operating costs). Ironically, transportation is being increasingly acknowledged as an essential component of social service programs. Since traditional public transit is oriented toward work trips and profits, we have seen a proliferation of efficient, narrowly focused transit programs come into being, funded and operated by social service agencies for the exclusive use of their clients. These inadequate programs have been forced into existence because of the failure of federal, state, and local transportation agencies to meet their responsibility for ensuring that all citizens have a viable transportation alternative.

It is hoped that meeting the needs of transit users as well as those who should be users but are not equitably served at present will emerge as a national priority in the near future. In recent testimony before the U.S. Senate Special Committee on Aging (5), William Bell and I presented results of 3 years of study (6, 7, 8) and suggested legislative action to help correct this deficiency. The research topics identified by the user workshop and the overall spirit of this conference create some optimism that forthcoming legislative improvements will be taken advantage of by more knowledgeable

transportation professionals and that future legislation and other public policy will be guided by information provided to political decision-makers.

Following are the research projects developed by Workshop 5:

- 5-1. Measuring the Quality of Public Transportation Service
- 5-2. Identification of Public Transportation Consumer Groups
- 5-3. Monitoring and Evaluation of Public Transportation Systems
- 5-4. Translation of Mobility Requirements of User Groups Into Specific Transportation Service Characteristics
- 5-5. Potential for Diversion of Automobile Commuters to Public Transportation
- 5-6. Information System Requirements of Transportation System Consequences
- 5-7. Assessing Benefits of a Public Transportation System for Users and the Community at Large
- 5-8. Demand Elasticities of User Groups as Related to Service Attributes
- 5-9. Measurement of Convenience for Auto Access

A detailed description of each research project is given in Part IV of this book. The top-ranked projects selected by this workshop were

- 5-1. Measuring the Quality of Public Transportation Service
- 5-2. Identification of Public Transportation Consumer Groups

REFERENCES

1. Orski, C. K. The Urban Transportation Planning Process: In Search of Improved Strategy. Highway Research Record 309, 1970, pp. 13-23.
2. Tomazinis, A. R. The Role of the States in Urban Mass Transit. Transportation Studies Center, University of Pennsylvania, 1971.
3. Webber, M. M. Alternative Styles for Citizen Participation in Transport Planning. Highway Research Record 356, 1971, pp. 6-11.
4. Travel Barriers. U.S. Department of Transportation, Office of the Secretary, Washington, D.C., May 1971.
5. Developments in Aging: 1973 and January-March 1974. Special Committee on Aging, United States Senate, Report No. 93-846, 1974, pp. 129-131.
6. Olsen, W. T. The Responsiveness of Public Transportation to the Service Requirements of the Elderly in Florida. In Towards a State Policy for Transportation and the Elderly in Florida, Conference Proceedings, Department of Urban and Regional Planning, Florida State University, 1971.
7. Olsen, W. T., and Bell, W. G. Social and Economic Benefits of New Transit Systems for the Transportation Disadvantaged: A Preliminary Position. In Toward a Working Partnership in Transit Programs for the Transportation Disadvantaged, Conference Proceedings, Department of Urban and Regional Planning, Florida State University, 1972.
8. Bell, W. G., and Olsen, W. T. An Overview of Public Transportation and the Elderly: New Directions for Social Policy. In New Directions in Planning and Action in Transit Programs for the Transportation Disadvantaged, Conference Proceedings, Department of Urban and Regional Planning, Florida State University, 1973.

WORKSHOP 6: THE COLLECTIVE PERSPECTIVE

Thomas B. Deen, Alan M. Voorhees and Associates, Inc., Chairman

THE general subject of evaluation measures for public transportation is broad enough that a group needs, if it is to deal comprehensively with the subject, to break it into pieces and attack each one at a time. The other workshops, of course, had such a focus, each dealing specifically with the problem of evaluation measures from the standpoint of the operator, the grantor, etc. However, Workshop 6 was the "collective group" and was to look at the problem from all of these perspectives plus others. In early discussions it became apparent that the breadth of the general subject was such that after several hours the group had only hit pieces of the problem, and there was concern about how one could deal with it comprehensively in a brief period.

Perhaps this breadth issue is the reason the workshop developed 16 research projects. It is fair to say that no one in the group felt that we had dealt comprehensively with research needs in transit evaluation, even with 16 projects. Nevertheless these are what were developed, and the group felt they were statements that dealt with research that could well be used in the transit field.

Of the 16 statements, 10 were concerned with the subject of evaluation; 5 involved increasing the number of options available to transit planners for new types of service; and 1 dealt with increasing the efficiency of existing transit to reduce costs and provide better service with less expenditure of public funds.

It is significant that the two research statements selected as highest priority did not deal with the subject of evaluation but rather dealt with the question of widening the range of options. This is symbolic of the basic thrust of the workshops' discussions, since there was great dissatisfaction expressed about the ability of conventional transit modes to satisfy the objectives desired from improved transit. There was also considerable concern expressed about whether the increasing amount of public works being devoted to transit was resulting in sufficient achievement of objectives. And there was a real question as to whether additional cash funneled into conventional transit would result in enough additional benefits. The escalating costs in the operation of conventional systems and the relative lack of response of additional patronage was the basis for these concerns. There was doubt expressed about whether taxpayers would continue to be willing to fund this type of activity indefinitely.

The committee believes there were other opportunities that in many instances could better fulfill transit objectives, such as increasing emphasis on bus priority, chartered service, jitneys, more competition on existing routes, and the elimination of legal, regulatory, organizational, and labor restraints to innovative approaches to service improvements.

The two research projects selected as highest priority are indicative of the committee's mood in this respect. Research statement 6-6 was aimed at developing more innovative service to either reduce the costs of conventional transit or to adjust both service and activities so that they could better serve each other. In the first instance, the idea was that the very high cost of supplying the equipment and drivers (many of whom had to be paid for a full day) for peak-hour service could perhaps be relieved by providing a lower level of conventional service and providing for peaks by using a version of paratransit services. In the second instance, research was aimed at attempting a detailed investigation of the needs of the transport-disadvantaged and identifying those activities such as medical, shopping, educational, and social that might be rescheduled so as to allow a relatively low level of paratransit activity to service well the resulting demands.

The second high-priority research project proposed dealt with examining the high proportion of non-CBD travel that was found in most cities and attempting to find ways

in which this demand might be better satisfied. Transportation surveys have indicated that anywhere from 70 to 90 percent of total travel has no destination or origin within the central business district. Despite this, conventional transit services are aimed primarily at, and most ridership comes from, CBD activities. To service the very large non-CBD market requires disaggregation of the market and identification of its components and the development of individual services to service various components of the non-CBD market.

Research projects 6-9, 6-10, and 6-11 dealt with the collection of data and the development of information that will be useful to planners and decision-makers in evaluating various types of improvements and the benefits to be gained from them.

During the last session of the workshop, the discussion moved in a more somber direction. Concern was expressed in the aggregate that the project statements did not express nor was the committee able to identify an overall central focus where the greatest needs were for better evaluation measures. The suggestion was made that our dilemma was caused by a lack of clarity in the objectives we wanted transit to satisfy. But this was rejected and the thought emerged that the problem was in a lack of refinement in our ability to measure consistently and with accepted scales the goals satisfaction produced by transit. However, after additional discussion it was concluded that the real problem was that the impacts of transit were too small to be measured. For example, if our laudable social objective of decreasing unemployment by providing transit service to low-income areas has had any impact at all, the effect has been so small that we have not been able to satisfactorily measure it. On the other hand, if we had been able to reduce unemployment by 15 or 20 percent, it is likely we would be able to measure it and recognize its significance. Similarly, if new transit service were able to decrease traffic congestion by 30 percent, no doubt we would be able to measure it. The problem seems to be that we are looking for a needle in a haystack and that the overall noise level in the system is sufficient to cause variations greater than the impact of transit.

Transportation systems in urban areas in the United States have recently received perhaps the biggest perturbation likely for years, first with the impact of the environmental protection laws that demanded the decrease in vehicle miles of travel in several areas and finally with the rapid increase in price of, and shortages of, fuel. The net result of all of this was that transit use increased by varying amounts but in the general range of 10 percent. Unfortunately, a 10 percent increase of a mode that is only carrying 10 percent of the travel in the first place is only 1 percent of total travel. Thus, even with an enormous and likely unrepeatable boost, we were able to demonstrate only a change on the order of 1 percent in the impact of the total system. During the conference, the group was cheered by relatively insignificant improvements that seemed to be moving in the right direction. For example, Frank Davis's report of the development of bus pools outside of the normal transit service area in Knoxville was very heartening, but it is clear, although we may hope that such innovations spread and thus have a larger impact, that as of the moment we are able to report very little impact on the total system by these kinds of activities.

All of this led the workshop to believe that we simply must have more options for new types of service, reduction in the constraints to innovation, and a recognition that our present course is not satisfying the objectives that society desires and even demands. Our solutions seem to be mostly of the Band-Aid variety while the patient is demanding major surgery.

Following are the research projects proposed by Workshop 6:

- 6-1. Effects of the Absence or Decline of Scheduled Public Transportation Services on Those Who Are Expected to Be Dependent on Transit
- 6-2. Benefits of Transforming Institutional Constraints to Incentives for Innovative Transit Service
- 6-3. Economic Impact of Labor Practices on Transit Efficiency and the Implications of Current Trends
- 6-4. Improved Techniques for Identifying and Serving Transit Market Requirements

- 6-5. Benefits of the Transit System Stratified by City Size (Not Limited to Dollar Measures)
- 6-6. Advantages of Scheduling Activities in Which Transit Users Engage to Be More Compatible With Efficient Transit Operations
- 6-7. Transit Alternatives for Non-CBD Travel
- 6-8. Development of Measures and Standards to Assist Definitions of Travel Service Levels
- 6-9. Development of Aggregate Measures Providing Comparison Between Cities of Levels of Services
- 6-10. Identification and Development of Standard Definitions and Techniques for Collecting Data Required for Evaluation and Performance Measures
- 6-11. Development of Standardized Benefit Measures for Transit Evaluation
- 6-12. Public Transportation Versus Other Community Services and Facilities
- 6-13. Classification of Alternative Service Concepts and Identification of Major Similarities and Differences in Layman's Terms
- 6-14. Analysis of the Relationship Between Transit System Evaluation Measures and the Variables Being Controlled That Affect the Evaluation Measures
- 6-15. Development of Guidelines for Methodology and Research Design for the Evaluation of Transit Service Demonstrations and Trials of Innovations

A detailed description of each research project is given in Part IV of this book. The top-ranked projects selected by this workshop were

- 6-6. Advantages of Scheduling Activities in Which Transit Users Engage to Be More Compatible With Efficient Transit Operations
- 6-7. Transit Alternatives for Non-CBD Travel
- 6-13. Classification of Alternative Service Concepts and Identification of Major Similarities and Differences in Layman's Terms

Part IV
RESEARCH PROJECT STATEMENTS

RESEARCH PROJECT STATEMENTS

Fifty-seven research project statements were developed by the six workshops at the Conference on Research Needs for Evaluating Urban Public Transportation. The research project statements are listed under the name of the workshop that developed them.

Each workshop worked independently, addressing the issues assigned to it, and therefore a number of project statements cover similar subject areas. No attempt has been made to combine the statements, because different workshops gave varying emphasis to such subjects. Furthermore, the fact that more than one workshop gave emphasis to a certain subject would indicate that any research should address the various perspectives considered by the different workshops.

The titles of the project statements are listed below by workshop group that developed the statements. The order of listing does not necessarily indicate any preference or ranking.

In the Index to Project Statements an attempt has been made to categorize the project statements under a limited number of general subject categories. Most project statements are listed more than once, under several categories. This Index will help the reader cross-check other research project statements that may call for similar or expanded research needs.

TITLES OF PROJECT STATEMENTS

Workshop 1: The Grantor's Role

- 1-1 Classification of Urban Areas
- 1-2 Development of Methodologies for Assessing and Evaluating Alternative Mobility Systems in Urban Areas
- 1-3 Identification of Rural Transit Needs and Methods of Meeting These Needs
- 1-4 Public Transit Operational and Managerial Training Needs
- 1-5 Motivational Research Needs Related to Modal Choice Decisions
- 1-6 Investigation of the Feasibility of Establishing a "Transportation Broker" Through a Case Study
- 1-7 Development of Appropriate Roles for Various Levels of Government
- 1-8 Identification of Potential for Private Sector to Satisfy Public Transportation Needs

Workshop 2: The Local Policy-Maker's Role

- 2-1 Financing of Transit Service to Meet Community Goals and Objectives

- 2-2 Examination of Alternative Organizational Forms for Delivery of Public Transportation Services
- 2-3 Use of Marketing Techniques to Evaluate Transit Services
- 2-4 Relation of Transit Service Attributes and Consumer Preferences

Workshop 3: The Planner's Role

- 3-1 Development of a Participatory Multimode Transportation Planning Process
- 3-2 Matching Transportation System Criteria to Transportation Goals
- 3-3 Identification and Measurement of Transportation System Costs and Benefits
- 3-4 Deriving Goals and Objectives for Transportation in Urban Areas
- 3-5 Methodology to Match Transportation Modes to Different Markets
- 3-6 Transit and Paratransit Forecasting Techniques
- 3-7 Techniques for Segmenting the Public Transit Market
- 3-8 Evaluation of Alternative Institutional Structures and Agency Responsibilities for Transportation Planning
- 3-9 Sketch Planning Techniques for Low-Capital Alternatives
- 3-10 Methodology for Measuring Transportation Impacts on Land Use
- 3-11 Manual of Performance and Operating Characteristics of Transit Modes
- 3-12 Determination of the Length of Time Required for Transportation Impacts to Occur

Workshop 4: The Operator's Role

- 4-1 Planning and Design of Mass Transportation Services to Meet Mobility Needs of the Elderly and Handicapped
- 4-2 Study of the Merits and Problems of Combining Some Transit, School Transportation, and Goods Movement With Transit Vehicles
- 4-3 Evaluation of the Purchase of New Transit Vehicles via the Consideration of New-Vehicle Quality as Measured Through Vehicle Maintenance Costs
- 4-4 Effectiveness of Federal and/or State Operating Subsidies for Urban Public Transportation
- 4-5 Development of Effective Marketing Disciplines for Promotion of Use of Club Buses, Subscription Bus Service, Special Charter Group Trips, etc.
- 4-6 Effect of Car Pool Promotions on Transit
- 4-7 Evaluation of Fare Packaging Procedures as a Tool for Inducing Transit Ridership and Reducing the Cost Associated With the Sale and Collection of Tickets
- 4-8 Use of Retired and Part-Time Personnel as Transit Employees
- 4-9 Human Resource and Development Needs for Expanding Transit Services

Workshop 5: The User's Perspective

- 5-1 Measuring the Quality of Public Transportation Service
- 5-2 Identification of Public Transportation Consumer Groups
- 5-3 Monitoring and Evaluation of Public Transportation Systems
- 5-4 Translation of Mobility Requirements of User Groups Into Specific Transportation Service Characteristics
- 5-5 Potential for Diversion of Automobile Commuters to Public Transportation
- 5-6 Information System Requirements of Transportation System Consequences
- 5-7 Assessing Benefits of a Public Transportation System for Users and the Community at Large
- 5-8 Demand Elasticities of User Groups as Related to Service Attributes
- 5-9 Measurement of Convenience for Automobile Access

Workshop 6: The Collective Perspective

- 6-1 Effects of the Absence or Decline of Scheduled Public Transportation Services on Those Who Are Expected to Be Dependent on Transit
- 6-2 Benefits of Transforming Institutional Constraints to Incentives for Innovative Transit Service
- 6-3 Economic Impact of Labor Practices on Transit Efficiency and the Implications of Current Trends
- 6-4 Improved Techniques for Identifying and Serving Transit Market Requirements
- 6-5 Benefits of the Transit System Stratified by City Size (Not Limited to Dollar Measures)
- 6-6 Advantages of Scheduling Activities in Which Transit Users Engage to Be More Compatible With Efficient Transit Operations
- 6-7 Transit Alternatives for Non-CBD Travel
- 6-8 Development of Measures and Standards to Assist Definitions of Travel Service Levels
- 6-9 Development of Aggregate Measures Providing Comparison Between Cities of Levels of Services
- 6-10 Identification and Development of Standard Definitions and Techniques for Collecting Data Required for Evaluation and Performance Measures
- 6-11 Development of Standardized Benefit Measures for Transit Evaluation
- 6-12 Public Transportation Versus Other Community Services and Facilities
- 6-13 Classification of Alternative Service Concepts and Identification of Major Similarities and Differences in Layman's Terms
- 6-14 Analysis of the Relationship Between Transit System Evaluation Measures and the Variables Being Controlled That Affect the Evaluation Measures
- 6-15 Development of Guidelines for Methodology and Research Design for the Evaluation of Transit Service Demonstrations and Trials of Innovations

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THE PROJECT STATEMENTS

Project No.: 1-1

Title: Classification of Urban Areas

Research Statement

Financial and technical assistance offered by governmental agencies requires policy decisions designed to achieve equal treatment of potential recipients experiencing similar transportation problems under like circumstances and conditions. Such policy equity is contingent upon the development of a research design and a methodology that are capable of ascertaining similarities and differences between and within groups of urban areas. Comparability is a prerequisite for all meaningful analytical inquiry into funding level decisions, alternative transportation system configurations, and relative measures of system performance. Comparative analysis must avoid overly simplistic concepts and typologies, such as "large", "medium", and "small" urban areas, unless they are demonstrated to be operationally definable and empirically significant.

Research Proposed

The intuitive and deductive approaches in comparative analysis of urban transportation systems should be replaced by more advanced methodologies of empirical inquiry.

Foremost among the new theories and techniques of urban classification is the work of Brian J. L. Berry of the University of Chicago.

Proposed research involves, initially, the development of a wide-ranging data bank of census and census-compatible information of profile characteristics of urbanized areas. Informational items should include population, land area, number of political subunits, economic and employment characteristics, ethnic distributions, number of households, household size, auto availability and public transportation usage levels, etc., supplemented by more specific transportation system information such as the number of transit companies in the urbanized area, route and mode mileage, operating data, financial assistance levels and sources of funds supporting public transportation, and environmental quality measures.

These social, economic, and demographic variables should be subjected to a multivariate statistical technique, i.e., factor analysis, to identify underlying dimensions or factors useful for categorizing or grouping urban areas. The generated factor scores for each case on each identifiable factor should provide the extensiveness and intensiveness of each typology. In addition, the analysis should suggest many multivariable indices to be substituted for single-factor measurements in allied research projects.

Priority: Urgent/high (Urban classification must precede governmental policy decisions and research in comparative urban transportation systems.)

Suggested Budget: \$150,000

Appropriate Funding Agency: Federal

Appropriate Research Agency: Federal and university or federal and consultant

Project No.: 1-2

Title: Development of Methodologies for Assessing and Evaluating Alternative Mobility Systems in Urban Areas

Research Statement

Transportation decision-makers at all governmental levels are constantly called on to make decisions that are intended to increase the efficiency of urban movement systems and result in increased mobility for transportation consumer groups. It is necessary for the federal government to have some indicators to assist them in the distribution of limited funds among several applicants. State transportation agencies are faced with this same problem. Local urban areas are frequently forced to evaluate projects without any means of assessing their effectiveness in relation to alternatives. This project seeks to develop indicator methodologies applicable to each of these

decision-making levels and areas.

Research Proposed

This research project should develop indicators that would provide assistance in (a) the federal or state distribution of capital matching grants and (b) local decisions related to improvement of mobility within urban areas. All possible modes, public and private, should be incorporated, and the cost-effectiveness of those for providing mobility should be operationalized. Consideration should be directed toward actual movement costs, energy costs, environmental costs, capital costs, and safety costs insofar as these are determinable. Methods to be used at the federal level should give thorough consideration to the appropriate role of local and state levels to ensure equity and cost-effectiveness; i.e., maximum local and/or state efforts should be integrated in the process. Results should be structured to provide capability for evaluating alternatives.

In developing these indicators the resulting report should (a) present an integrated measurement system that may be utilized at all levels, (b) provide a system that will be easy for local officials to interpret, (c) illustrate how the system can be used at the macro and micro level to evaluate progress over time, (d) utilize existing data to the maximum extent possible and if necessary outline cost-effective sampling schemes for data not available, and (e) provide a manual for the utilization of the indicator system(s) in different classes of urban areas.

Priority: Urgent

Suggested Budget: \$500,000

Suggested Project Length: 1 year +

Appropriate Funding Agency: Federal and university

Project No.: 1-3

Title: Identification of Rural Transit Needs and Methods of Meeting These Needs

Research Statement

There is a need to identify the extent to which a rural transportation problem exists in the United States. Methodologies that would enable grantors to identify the scope and magnitude of the problem should be developed. The literature on this problem should be reviewed and possible solutions to the problem identified. Experience in other countries should be noted where applicable. Possible modes for the provision

of rural transit, whether public or private, should be identified, along with the institutional barriers to utilization of these alternate modes. The research should not neglect the potential cost-effectiveness of combining transit service with goods movement.

Research in this area is needed to ensure the maximum return from funding provided in federal highway and public transportation legislation.

Research Proposed

The research should concentrate on the "market" segments in rural areas that are poor, aged, and/or involved in the production of goods and services necessitating a rural location. However, some investigation into the recreational and social public transportation needs should be included.

The methodology developed must be capable of assessing the national magnitude of the problem. Generally, census documentation and data sources appear to be the most applicable data source for this use.

Reviews of literature should be included and must be comprehensive, with translations where relevant.

Among the modes considered should be taxi and other demand-responsive systems, conventional transit systems, school bus systems, etc. A comparative cost analysis of these systems should be included. Institutional barriers should be identified for each mode of approach offered.

Priority: Urgent

Suggested Budget: \$60,000

Suggested Project Length: 9 months

Appropriate Funding Agency: Federal

Appropriate Research Agency: Consultant and university

Project No.: 1-4

Title: Public Transit Operational and Managerial Training Needs

Research Statement

Many public transit authorities are beset by the problem of operational and managerial personnel lacking the expertise required to discharge their responsibilities with

the efficiency that transit now demands and, at the same time, are financially unable to correct this situation. Traditionally, transit operations have been the responsibility of career personnel who have generally risen through the ranks. In most instances, zeal to keep the vehicles rolling is not lacking, but the personnel are deficient in the requisite skills to effectively "manage" the operations.

Transit is an unusual, if not unique, type of business where there can be no substitute for personal experience in these subject areas.

The answer is (a) to superimpose on existing operational and managerial personnel the necessary training to enable them to become efficient and to acquire the expertise their jobs demand and (b) promote training for key employees who are entering the managerial level.

Research Proposed

The objectives would require the following: (a) a survey of the involved positions based on an adequate sample of transit operations varying in locations, size, operating conditions, organizational structures, and union restrictions to obtain requisite job data; (b) analysis of compilation of job data; (c) proposed program design to improve managerial expertise and to improve and update various methods and techniques; (d) an instructional program to train employees at workshops and to qualify them as trainers (this phase should also formulate detailed instructions with examples); (e) training modules to be available at no or very moderate cost; and (f) follow-up workshops to ensure maximum beneficial results and to effectuate changes and improvements.

This program should help to assure the public of maximum beneficial results from federal grants.

Priority: Urgent (The potential savings to all levels of government are substantial.)

Suggested Budget: \$500,000

Suggested Project Length: 18 months

Appropriate Funding Agency: Federal

Appropriate Research Agency: University

Project No. : 1-5

Title: Motivational Research Needs Related to Modal Choice Decisions

Research Statement

The traditional "more of the same" approach to transit service has not been an overwhelming success. There seems to be more to stimulating transit demand than preoccupation with travel time and a rational analysis of costs. Public transportation service should be designed to capitalize on the behavioral characteristics of those served. Research must be performed that identifies the true attitude of people toward transit (as distinguished from their stated attitude) and the reasons therefor as well as the factors that influence both the use and nonuse of transit. Once these are identified and their relative values determined, service can be designed to take advantage of the positive aspects and to mitigate the negative factors.

Research Proposed

The analyses should utilize the techniques of motivational research to identify factors such as status, patriotism, civic pride, and personal safety that affect mode choice. Relative values should be determined for these more obscure factors as well as relative values for the more traditional SCARCE (safety, comfort, accessibility, reliability, cost comparative, and efficiency) factors. The interaction of all factors in influencing mode choice should be determined. The final step of this task would be the creation of a generalized transit service design that makes use of this new insight to achieve policy objectives concerning allocation of resources to transportation modes.

Priority: Urgent

Suggested Budget: \$250,000

Suggested Project Length: 18 months

Appropriate Funding Agency: Federal

Appropriate Research Agency: Consultant

Project No. : 1-6

Title: Investigation of the Feasibility of Establishing a "Transportation Broker"
Through a Case Study

Research Statement

Present emphasis is on establishing public transportation systems. Often this is done to the detriment of other involvements in the transportation spectrum. There are rational reasons for both private and publicly owned systems. Establishing a "transportation broker" who would determine the best mix of the two systems and the potential of reducing the overall cost of providing for public transportation could be useful in resolving such situations. The broker would identify regulatory and other constraints that inhibit productivity and stifle innovation.

At present grantor funds come in three forms: direct subsidy, capital grants, and indirect subsidy (of which the grantor may be unaware). The indirect subsidy flows through other agencies and institutions that provide transportation services to achieve their particular goals. By increasing the effectiveness of the indirect subsidy programs, public (grantor) funds will be saved and the transportation service still improved.

Research Proposed

Identify all transportation facilities in a case study state where its communities provide various transportation services including taxis, buses, railroads, rapid transit, and voluntary and special equipment for emergency and handicapped use. Identify the agencies that include in their budgets transportation for their particular functions. These include agencies on the federal, state, and local levels, such as VA, HEW, OVR, social service, police, and schools. Investigate the feasibility of establishing a central clearinghouse to provide the existing transportation systems with information and to identify the need for services not covered by existing modes. Investigate methods and terminology of agencies to determine how transportation costs are allocated and whether some of these costs are being supplied through other budget items, such as purchase of equipment and maintenance of buildings and grounds. Recommend improvements to maximize investment return or reduce funding necessary to provide equal or improved services.

Priority: Urgent

Suggested Budget: \$300,000

Suggested Project Length: 18 months

Project No. : 1-7

Title: Development of Appropriate Roles for Various Levels of Government

Research Statement

At present there is little coordination of such activities as marketing, training, safety, and planning among the various levels of government, and needless duplication occurs. Various levels of government have legitimate interests in these areas and the research should focus on identification of the level of government most appropriate to carry out identified activities. Besides minimizing duplication this research may identify needs not currently addressed. Establishment of a permanent information system may be found necessary to maximize the effectiveness of this program so that various levels of government can obtain information developed by others.

Research Proposed

1. Establish a listing of necessary activities within the identified areas.
2. Inventory activities currently under way by the various organizations.
 - a. Use representative state, regional, and local organizations as appropriate with funding allocated for study.
 - b. Consider classification of various governmental units—e.g., states with and without transportation departments.
3. Determine federal responsibilities in accordance with:
 - a. federal legislation;
 - b. various federal goals and policy statements;
 - c. needs for implementation of research, development, and demonstration programs; and
 - d. other mandates.
4. Establish which of the remaining activities may be best performed by state, regional, or local agencies, understanding that
 - a. No exact listing can be assembled as governmental responsibilities, needs, etc., vary by states and areas; and
 - b. Activity priorities and involvements by levels of government will change with external conditions.
5. Study need for establishing transportation information center.
6. Recommend form of information exchange to cover program intent if found necessary.
7. Recommend method of keeping program current.

Priority: Urgent

Suggested Budget: \$50,000

Suggested Project Length: 6 months

Appropriate Funding Agency: Federal

Project No.: 1-8

Title: Identification of Potential for Private Sector to Satisfy Public Transportation Needs

Research Statement

Current emphasis in providing for public transportation is focused on activities in the public sector. It is felt that there is considerable opportunity for private-sector involvement. This would have many advantages. This program is to identify such opportunities with possible follow-up studies to be recommended.

Research Proposed

1. Inventory existing data on private-sector involvement.
2. Identify spectrum of other activities that can be combined with public transportation to form a viable operation.
3. Using 1972 needs study, National Transportation Study, or similar appropriate information, identify potential market for private involvement.
4. Determine in gross terms inhibitors of such involvement.
5. Identify potential sources of information for assistance in establishing private-sector involvement.
6. Identify potential for further study and make recommendations.

Priority: Urgent

Suggested Budget: \$25,000

Suggested Project Length: 3 months

Appropriate Funding Agency: Federal

Appropriate Research Agency: Federal, university, consultant

Project No. : 2-1Title: Financing Transit Service to Meet Community Goals and ObjectivesResearch Statement

Public transportation in urban areas today is largely a deficit service—a factor that has led to increasing public financial participation in providing the necessary service. For some jurisdictions the problem of financing the deficits is more severe than in others. Nonetheless, all jurisdictions must be acutely aware of the fact that, with the continuing escalation of costs, with the desires of user groups for expanded public transportation, and with pressures to retain or institute low fares for various policy reasons, the problem of deficits will be a growing one.

There is a need to determine the relationship between alternative transit service "packages" and the degree to which they meet certain community goals and objectives, e.g., reduced peak-hour traffic, mobility for the transit-dependent, desired land use development patterns, improved air quality, and reduced auto ownership and use. Various levels of public subsidy are required to enhance the attractiveness of a given transit service to the user to where he is willing or able to use the service for a particular user charge. A method of calculating the cost-effectiveness of various approaches to providing transit services in meeting community goals and objectives by increasing transit use above that which can be justified by user charges should be determined.

An essential policy decision that must be resolved at the local level is what portion of the costs of the service provided should be covered by user charges and, to the extent that these fares do not cover costs, how the difference should be financed. This requires (a) an evaluation of various possible fare strategies; (b) an evaluation of who the real beneficiaries are of the transportation service provided; and (c) a determination of an equitable and workable basis by which the total cost of service can be distributed to these beneficiaries.

Research Proposed

- I. Determination of fact base through evaluations of
 - A. How severe is the emerging problem of deficits?
 - B. Why are there deficits?
 1. Fare policy
 2. Cost structure
 3. Inappropriate service
 - C. Whether the internal distribution of costs and services provided is equitable relative to the use and revenues derived from the various market segments
 - D. How the excess of cost over revenue is covered for services provided:
 1. Internal transfers
 2. Local efforts
 3. Regional efforts
 4. State efforts
 5. National efforts
 - E. Who, beyond the users, are the beneficiaries of public transportation services and whether the benefit can be quantified, even in broad terms
- II. Evaluation of policy alternatives: Examine alternative transit service packages and their associated costs in achieving different impact levels in meeting particular community goals and objectives. Relate trade-offs between higher levels of transit service and use and the amount of subsidy required:
 - A. Fares—What are the parameters for recovery of costs through fares from various classes of users at various levels of service?

B. Costs—What are the resources available for charging back costs incurred in meeting particular community objectives?

C. Deficit—To the extent that a deficit still exists for the public transportation system, what are the most equitable ways by which the deficit can be distributed (e.g., dedicated tax, general revenues)?

Develop a methodology for selecting between alternative approaches and levels of transit service to achieve particular impacts on community objectives. Determine a method of measuring and/or calculating the effectiveness of the transit service once it becomes operational.

Priority: Urgent

Suggested Budget: \$200,000

Suggested Project Length: 18 months

Appropriate Funding Agency: Federal

Appropriate Research Agency: Consultant

Project No.: 2-2

Title: Examination of Alternative Organizational Forms for Delivery of Public Transportation Services

Research Statement

Fragmentation in the organizational framework through which urban public transportation is provided continually acts to retard and inhibit new and innovative solutions to transit problems. Responsibilities for operations, planning and development, goal-setting, financing, and marketing are assumed by various agencies on all levels of government and in the private sector. This diversity in structural elements of the process in which transit services are delivered makes effective decision-making and action extremely difficult.

Research Proposed

The objective of the proposed research is to investigate and evaluate existing and emerging methods of organizational structure in order to facilitate the selection by particular urban areas of the structure that will best suit their unique situations.

The research should investigate the following elements of organizational structure

as related to the delivery of urban public transportation:

- I. Directorship (board, authority or whatever)
 - A. Structure
 1. Organization: if appointed, by whom
 - a. Expert board of directors
 - b. Representational
 - c. Elected officials
 2. Organization: if elected, by whom
 - a. Expert
 - b. Representational
 - B. Powers
 1. Scope
 - a. Transportation service for the public
 - b. Transportation facilities
 - c. Review of land use proposals
 2. Area
 - a. Geographic area coverage
 - b. Governmental interrelationships
 3. Regulatory Powers
 - a. Entry
 - b. Rates
 - c. Service
 4. Financial
 - a. Method of support
 - b. Area of support
 - C. Staff Needs
 1. Types of staff services
 2. Number of personnel, based on size of urban area and scope of activities
 - D. Relation to Public
 1. Method of feedback
 - a. Public meetings and hearings
 - b. Election
 - c. Citizen advisory board
 2. Translation of public will into action
- II. Options for management of operation
 - A. Type of management
 1. In-house staff
 2. Management contract
 - B. Management performance
 1. Meeting goals prescribed
 2. Incentives
 - C. Organizational structure
 1. Fit to goals and objectives
 2. Marketing orientation

Priority: Urgent

Suggested Budget: \$200,000

Suggested Project Length: 18 months

Appropriate Funding Agency: Federal and Transportation Research Board

Appropriate Research Agency: Consultant

Project No.: 2-3

Title: Use of Marketing Techniques to Evaluate Transit Services

Research Statement

In evaluating urban transportation service for the public there has been extensive effort to establish levels of service that allow comparison of alternative modes, ownership, and operating methods. One difficulty in setting service standards has been the emphasis on setting a single standard for a single system to meet the assumed needs of a stereotyped homogeneous public. In reality, communities are composed of vastly different market segments, with greatly varying travel patterns requiring a multiplicity of service levels, types, and operating techniques. This concentration on single systems has led to the wasteful provision of service during periods of low demand and the provision of inflexible service unsuitable to large groups whose travel patterns differ substantially from the established operating patterns of existing systems.

Research Proposed

The objective of the proposed research is to develop better methods to allow a region, commission, or transit authority to specifically identify the amount of transportation actually required in their community and tailor the service provided to the public's specific needs.

The output of the market evaluation study would then be used in conjunction with the service evaluation studies to enable policy-makers to determine the market that should be served, operators to determine how to modify service, and the grantor to determine the benefit of proposed programs.

This research should determine how to

1. Identify various groups within communities with similar travel needs and patterns—i.e., commuters, senior citizens, medical and social service trips;
2. Classify various market segments by type of service required—i.e., peak-hour highly reliable; off-peak package facility service for elderly, etc.;
3. Determine sensitivity or elasticity of each of these segments to varying service levels;
4. Develop methodologies that local communities can use to identify the magnitude and location of various market segments having similar travel needs, and test this methodology by using existing data in an area to validate techniques; and
5. Develop methods for continually measuring and evaluating the effectiveness of current transportation services and determining market share of each service.

Although this research is addressed to the evaluation of marketing identification, it should be stressed that it is ultimately inseparable from service evaluation, cost evaluation, and overall policy. There must be constant and continual interplay and exchange of information so that no isolated conclusion is drawn.

Project No. : 2-4

Title: Relation of Transit Service Attributes and Consumer Preferences

Research Statement

There exists a need to describe the characteristics of existing transit service "packages" and the alternative means of providing such services such as traditional fixed-route systems, paratransit, or combinations of the two. In addition there is a need to relate the above to the consumer of transit services and describe the view of different groups toward attributes of service such as travel time, walking distances, waiting time, dependability, cost, and comfort. These alternative transit service "packages" would be compared to consumer preferences by market segment.

Research Proposed

Select urban areas or corridors within urban areas where alternative transit service packages now exist. Compare the service attributes for each subsystem and relate the service characteristics to user satisfaction and defined market penetration. Recommend a methodology that urban areas can use to select among alternative transit service packages for different levels of demand. Develop a procedure to measure and/or calculate the effectiveness of the transit service once it is installed and operating.

Priority: High

Suggested Budget: \$200,000

Suggested Project Length: 18 months

Appropriate Funding Agency: Transportation Research Board

Appropriate Research Agency: Consultant

Project No. : 3-1

Title: Development of a Participatory Multimode Transportation Planning Process

Research Statement

Many previous multimode transportation planning processes (and the resulting studies and plans) have resulted in problems and justifiable criticism. Some of these efforts have clearly not been responsive to the real needs of the metropolitan areas and have therefore been ignored or have served only as the focal point of widespread disagreements leading to inaction or compromise programs put together on a crash basis.

The transportation planning process needs to be revised to incorporate the participation and viewpoints of a representative segment of the area's citizens, decision-makers, and funding agencies. As a minimum, the following groups should participate in the process, with knowledgeable planners providing resource information and guidance: citizens, appropriate levels of government (local elected officials), special-interest groups, planning agencies (city and/or regional), transit authority (if existing), and state DOT and/or highway department. Although there may be common elements in a satisfactory approach, there are probably significant differences related to the size of the metropolitan area, types of local governments, nature of the event triggering the process, and other factors.

Research Proposed

The research project should be structured in three stages: (a) development of a responsive and widely acceptable participatory process; (b) field testing of the process in several different types of metropolitan areas and sets of circumstances; and (c) evaluation and refinement of the process. The final (and intermediate) end products would be a series of manuals and user guides directed at each group intended to participate in the process.

The first step in the research should be the determination of the advantages and shortcomings of the planning process as experienced in a representative sample of metropolitan areas that have completed such studies. This sampling should include different-sized metro areas where the planning process has been deemed good, marginal, and poor, to provide a basis for developing a proper approach. (This step requires the development of criteria for evaluating good, marginal, and poor results with respect to satisfaction with the process and results of the process.)

The process should address two time frames: short-range (or immediate action) and long-range.

The evaluation of previous planning efforts will identify the specific elements of the processes to be retained and amplified as well as those to be avoided, but it is probable that the role of the planner, although primarily as a catalyst or leader, also may include the following (as appropriate, the ways to achieve these points should be defined):

1. Establishes credibility for the process and relates to decision-makers;
2. Establishes the necessary lines of communication;
3. Helps identify the participants and their roles;
4. Assists in the formulation of goals and objectives;
5. Assists in the identification of alternatives;
6. Assists in the evaluation of alternatives; and
7. Performs technical analyses.

The term planner represents a multidisciplinary team. Although the research

project would identify the appropriate specialties, it is probable that the following would be included: comprehensive planning, transportation planning, environmental engineering, sociology, economics, and public administration.

Priority: Urgent

Suggested Budget: \$400,000

Suggested Project Length: 18-24 months

Project No.: 3-2

Title: Matching Transportation System Criteria to Transportation Goals

Research Statement

In order to attain a specific set of transportation goals in an area, the attributes and impacts of a proposed transportation system must meet a certain set of criteria. To date many criteria have been identified in the transportation literature. Many have not been quantified. Discussions of these criteria in the field include some that have relatively little effect on the attainment of major transportation goals and exclude some that have considerable effect on the attainment of these goals. No uniform set of criteria currently exists in the transportation field that can be used by all planners. All of the significant transportation attributes and impacts must be identified and then used to develop criteria that are usable to any planner seeking to develop a transportation system that will meet the intended transportation goals of an area.

Research Proposed

The objectives of the research are (a) to evaluate existing determinations of criteria by examining the choice of transportation attributes and impacts, the measurement of these attributes and impacts, and the establishment of criteria based on these measurements and (b) to develop a set of criteria that fully establish a correspondence between the measurements of the attributes and impacts and the attainment of transportation goals.

To meet the first objective, a thorough review of existing literature that addresses these criteria must be made to gain a working knowledge of the present state of the art. Existing determination of criteria will be evaluated by examining whether (a) the attributes and impacts used affect the goals of transportation systems, (b) the measurements of the attributes and impacts have been quantified, and (c) a correspondence has been established by the criteria between the measurements and the attainment of transportation goals.

To meet the second objective, an acceptable set of criteria will be developed as

follows: (a) Those transportation attributes and impacts that affect the attainment of transportation goals will be ascertained; (b) ways to measure the attributes and impacts will be developed and the attributes and impacts whose measurements cannot be quantified should be considered for further research; and (c) criteria that establish the correspondence between the measurements of each of the chosen attributes and impacts and the attainment of transportation goals will then be produced.

The product of this study will be a manual that documents (a) a wide range of criteria, (b) methodology for measuring the criteria, (c) correspondence between the criteria and a general set of goals and objectives, and (d) criteria requiring further research.

Priority: Urgent

Suggested Budget: \$250,000

Suggested Project Length: 18 months

Project No.: 3-3

Title: Identification and Measurement of Transportation System Costs and Benefits

Research Statement

Given an urban area, a set of goals, and a set of alternative transportation systems for the area, a critical problem in the planning process remains: that of selecting the best alternative system for the area. The method of cost-benefit or cost-effectiveness analysis was developed precisely for use in selecting the "best" of a number of alternative courses of action. As such, it is directly applicable to the problem of selecting the best alternative transportation system for the area. The utility of the method is constrained, however, by the ability to determine sets of costs and benefits that are (a) truly indicative of the goals, (b) common to all alternative systems, (c) measurable, and (d) complete. Examples of attributes of transportation systems that are difficult to determine in a cost-benefit sense are safety, aesthetics, comfort, convenience, and reliability. Examples of effects of transportation systems that are frequently not considered or are difficult to determine are "hidden" or secondary costs such as street maintenance, traffic control including signals, police, and school crossing guards, and such secondary effects as impact on the community's economy in terms of direct and indirect changes in employment and retail and wholesale sales.

To perform the best evaluation and to make the best selection, such factors should be considered to the maximum extent that is reasonable.

Research Proposed

To enhance the planner's ability to evaluate transportation systems and to select the best alternative, a two-phase research project should be conducted.

The product of the first phase would be (a) a survey of transit studies and research to determine the state of the art in applying cost-benefit analytical techniques and in measuring costs and benefits; (b) a comprehensive listing of measureable transportation system costs and benefits; (c) methods of measuring those costs and benefits for which the measurement method is not obvious; (d) cost of any data collection and analysis required to obtain the measurements; and (e) a suggested classification of costs and benefits into sets appropriate for evaluating transportation systems in various sizes of cities.

In most cases, measurement of costs and benefits will be a two-stage process. First, the raw measure of the transportation system attribute of effect must be made (e.g., ride time, energy consumed, degree of comfort); second, the raw measure must be converted to a common basis (typically dollars) to permit aggregation into overall cost and overall benefit. Thus, conversion factors such as the dollar value of a unit of time and a unit of comfort must also be determined. Existing or known methods and conversion factors should be utilized to the maximum extent possible.

In the second phase, a specific community will be selected and the cost-benefit methodology exercised. The selected community should be one considering a substantial change in its existing transportation system. Furthermore, in conducting the case study, the total passenger transportation system of the community must be considered. Thus, in those alternatives in which the private automobile is an integral part, cost and benefits of the automobile portion must be considered.

Priority: Urgent

Suggested Budget: \$200,000 for Phase I and \$200,000 for Phase II

Suggested Project Length: 12 months for Phase I and 12 months for Phase II

Project No.: 3-4

Title: Deriving Goals and Objectives for Transportation in Urban Areas

Research Statement

It seems that before launching on any worthwhile endeavor such as the creation or improvement of a transportation system it is practical if not necessary to develop an adequate and appropriate set of goals and objectives. Some criteria for the development of goals and objectives have been developed, but most consider overall development or rather broad areas such as the need to improve education or transportation. There seems to be a great need to develop a set of guidelines for developing or defining

goals and objectives in specialized areas such as for transportation, especially in smaller communities (less than 100,000 in population). Often these communities are aware that a problem exists but have difficulty in defining the problem. A methodology is needed for assisting urban areas in the development of adequate and appropriate goals and objectives that are applicable to their transportation needs. Four phases are included in the process: (a) definition of goals and objectives, (b) development of a set of goals and objectives, (c) discussion of appropriate goals and objectives applicable to the communities' specific needs in transportation, and (d) final compilation of a comprehensive list of generic goals and objectives that can be used in the development of the foregoing three. The methodology for defining, developing, and accepting or agreeing on a set of goals and objectives must be applicable to any size of urban community.

A set of goals and objectives that satisfy the transportation needs of Chicago, with 7,000,000 people, will in no way be appropriate for Johnson City, Tennessee, with a population of about 28,000. Therefore, the methodology must be scaled to the size of the urban area, or the methodology must be adequate to any size of urban area.

Research Proposed

Some criteria for defining and developing goals and objectives do exist, such as the report, "Goals for Dallas". Some of these even include criteria for getting the community to agree on a set. The first effort should then be directed toward a literature search. The next step should identify urban areas that have developed goals and objectives. Once areas have been delineated where adequate, appropriate, and workable goals and objectives have been defined, developed, agreed on, and used, visits should be made to gain first-hand knowledge of the processes and methodologies used. Other processes are also available for gaining insight into usable criteria, such as interviews and survey forms.

The final product should include two manuals. The first manual should contain procedures for defining goals and objectives for transportation or criteria for developing a set of goals and objectives and procedures for effecting agreement on a usable and workable set of goals and objectives. The second manual should include a broad and comprehensive list of goals and objectives pertaining to transportation that can be drawn from by urban communities. Both the manuals and the criteria for formulating goals and objectives must be applicable to various sizes of urban communities or areas.

It seems appropriate to test the methodology once it has been developed. The test sites should be chosen carefully and should include urban areas with small, medium, and large populations. The methodology should then be reevaluated, amended, and refined as necessary.

Suggested Budget: \$200,000

Suggested Project Length: 24 months

Project No. : 3-5

Title: Methodology to Match Transportation Modes to Different Markets

Research Statement

Transportation modes have often been looked at as competitive rather than complementing one another in terms of satisfying travel desires effectively and efficiently. Many cities have found that a rail line is not a solution without a collection and distribution system. Conversely, collection systems alone have been shown to provide only a partial service when isolated. However, the integration, for example, of a line-haul bus operation with a dial-a-ride bus operation in certain systems has improved the integrated system in terms of ridership revenues and service. There is a need for developing criteria and methodologies that would integrate difficult transportation modes to match in an optimum manner the transportation and land development needs and desires.

Research Proposed

This research should result in a manual indicating the different characteristics of the transportation modes and how and where they can be utilized to serve specific transportation markets. An analysis of data on existing systems should be performed to determine systems criteria in terms of capacity, costs, travel time, door-to-door service, speed, headways, level of service, productivity, demand densities, etc. Conversely, an analysis of data on transportation needs and desires should be made in terms of type of trip, occurrence, time distribution, length of trip, socioeconomic characteristics of the market areas, etc. From the analysis of the two sets of parameters a matching scheme should be devised showing how the different modes can be integrated to serve the different market needs optimally.

The developed methodology should be tested in an urban area to be selected.

Priority: High

Suggested Budget: \$250,000

Suggested Project Length: 18 months

Project No. : 3-6

Title: Transit and Paratransit Forecasting Techniques

Research Statement

To effectively plan transportation systems, a participatory, multimodal planning process is necessary. To evaluate alternative systems plans, however, comparable data on each alternative are needed. Demand estimation techniques are available for planning highway facilities, but the same types of techniques are almost completely lacking for transit and paratransit modes. To provide a timely response to this problem, it is important that the techniques developed be relatively simple, inexpensive, and quick. Although applications of these techniques alone are not a sufficient basis on which to evaluate alternative systems, without empirical estimates, comparisons of system demands and use can only be made subjectively.

Research Proposed

Recent research efforts have been directed at the development of "quick-and-dirty" demand estimation procedures, and, in fact, such methods can be developed and can provide reasonable estimates on which systems planning can be done. This research, however, has not been broad enough to provide the basis needed for the comparison of systems alternatives. This research is proposed as a coordinated and comprehensive approach to the development of these techniques. First, the research should identify available data, needed data, data sources, and data collection techniques. Second, demand forecasting techniques should be developed for both transit and paratransit modes. Disaggregate behavioral techniques should be used where appropriate. Third, sensitivity measures should be incorporated in these techniques to evaluate the effects of time, cost, and other related variables on demand. Fourth, the methods should be field-tested and verified, and demonstrations should be conducted whenever existing conditions do not permit testing of the methodologies. Refinement of the techniques based on these tests should follow. Above all, the techniques must be relatively simple to use, require little time between initiation and demand estimation, and be inexpensive to use. The techniques developed should include, but not be limited to, estimation procedures for demand-actuated systems (and variations on them), park-and-ride services, car pools, jitneys, fixed-route and fixed-schedule transit, taxi, and shared-ride systems. Finally, dissemination of the results of this work is the key to its success. Prompt publication and distribution to transportation operators, planners, and evaluating groups are required.

Priority: Urgent

Suggested Budget: \$200,000

Suggested Project Length: 18 months

Project No.: 3-7

Title: Techniques for Segmenting the Public Transit Market

Research Statement

Mass transit has historically served, as a prime objective, the commuter segment of our population. When economically feasible, service has been rendered to off-peak and counterflow users. In most instances, institution of this service was based on a visible demand. In other cases, an operator was forced through various methods to supply service, even at a loss. The decline of the transit industry, for various reasons, has resulted in no service in many areas. Through funding currently provided at federal, state, and local levels, some systems offering minimum service have survived, and others are being rebuilt. In this rebirth of transit, emphasis is being directed to segments of our population that have not previously fit the "economically feasible" criteria. Such segments include the elderly and the handicapped, along with various other markets for transit. It is therefore necessary to segment the mass transit market in order to adequately prescribe service needs.

Research Proposed

A critical objective of this research problem is to identify, as population segments, those groups within our universe that either represent the traditional transit "potential", or, under the emerging definition of mass transit, those groups that should have some level of service. Techniques must be developed to identify these segments in terms that the transit planner and operator are able to respond to. Unfortunately, such segments do not often reside as geographic clusters. In addition to identifying the segments, locations on an individual basis must be determined, with specific service and vehicle design requirements established.

This research project proposal would include (a) selection of an urban area that would appear to contain as many "segments" as are known and large enough to contain the probable unknown; (b) segment identification techniques that include surveys, meetings, and contacts with all agencies currently involved with providing health and social services, etc.; (c) identification of available transit service to each segment along with the actual use that is made or reasons why service is not utilized—i.e., cost, frequency, routes, etc.; and (d) a determination in all cases as to what the service requirements would ideally be to meet desired or necessary activities, such as doctor appointments.

The project will result in (a) usable market segmentation techniques; (b) identification of the segments; (c) an analysis of the unfilled need for service to all segments, including service and vehicle design requirements to fill the needs of each segment; and (d) a final report detailing market segmentation techniques used and methods of analysis.

Priority: High

Suggested Budget: \$100,000

Suggested Project Length: 2 man-years

Project No.: 3-8

Title: Evaluation of Alternative Institutional Structures and Agency Responsibilities for Transportation Planning

Research Statement

In recent years a number of factors have interacted to produce significant changes in the transportation planning environment, creating a need for reevaluation of institutional arrangements and agency responsibilities. These factors include (a) emphasis on multimodal planning and coordination; (b) a shift from traditional "long-range" planning to "policy" planning (i.e., a shift from "product" to "process"); (c) increased citizen involvement; (d) development of the multidisciplinary team approach; (e) increased acceptance of multijurisdictional planning agencies (COGs, development districts, regional commissions); (f) creation of state DOTs, with state involvement in new areas such as mass transit; (g) increased use of local options in expenditure of federal funds; and (h) availability of federal funds for ongoing transportation planning at the local level.

These changes are requiring that local, state, and federal officials, planners, and operating agencies reassess organizational arrangements and agency responsibilities in the transportation planning process. Many of these individuals and organizations do not have an understanding or, in some cases, an awareness of the many factors that should be considered in this reassessment process.

Research Proposed

The proposed research would provide an overview of existing institutions and agency responsibilities, a summary of recent changes in the transportation planning environment, and recommendation for improvements. The project tasks could be organized as follows: (a) review of federal and state legislation (current and pending) to identify and summarize planning programs and requirements; (b) review of federal and state administrative policies to identify and summarize planning programs and requirements; (c) summarizing general concepts (such as the eight factors listed above) that affect the transportation planning environment; (d) development of broad criteria for analyzing, and possibly ranking, the effectiveness of alternative institutions and agency responsibilities; and (e) recommending new or adjusted institutions and agency responsibilities.

Priority: Urgent

Suggested Budget: \$100,000

Suggested Project Length: 12 months

Project No. : 3-9

Title: Sketch Planning Techniques for Low-Capital Alternatives

Research Statement

Increasing attention in the planning process is being given to the identification and evaluation of a wide range of low-capital and service-oriented transportation alternatives. At present, there are no techniques available to assist planners to quickly evaluate such alternatives. Without these sketch planning techniques, planners will find it difficult to adequately consider low-capital alternatives.

Research Proposed

The product of this project is a set of sketch planning techniques in a form usable to planners for the assessment of a wide range of low-capital and service-oriented alternatives. These alternatives shall include, but not be limited to, bus route changes that do not affect major portions of the network, taxi and jitney services, shared riding, commuter bus services, and express bus services.

The sketch planning techniques shall be simple and inexpensive to operate and provide results quickly.

The project shall proceed through the following phases:

1. Identification and documentation of existing techniques and knowledge relevant to sketch planning techniques for low-capital options;
2. Development of one or more sketch planning techniques;
3. Determining data requirements for the techniques developed in phase 2;
4. Assembly of data sets to calculate and test the techniques developed in phase 2;
5. Calibration of the techniques developed in phase 2;
6. Testing the techniques, including a sensitivity analysis;
7. Refining the sketch planning techniques based on the tests performed in phase 6;
8. Development of a manual for the techniques that is usable by planners; and
9. Pilot-testing the sketch planning techniques in one or more urban areas using actual transportation issues and problems in these areas.

Priority: Urgent

Suggested Budget: \$250,000

Suggested Project Length: 18 months

Project No.: 3-10

Title: Methodology for Measuring Transportation Impacts on Land Use

Research Statement

Transportation planning has mostly been considering land use as an input to the process rather than an integral part of it. That is to say, a land use plan is obtained from urban planners, and transportation planners attempt to devise a transportation system with no interaction with its impacts on land development. This is true in both highway and transit facilities. In fact, many of the impacts of these systems are not known to the planner in terms of how each mode affects land use in terms of impacts on routes, levels of service, accessibility, stations and terminals, etc.

Research Proposed

This research should identify all the transportation factors that affect land development in terms of systems facilities, operating characteristics, stations and terminals, and other factors in addition to impact of land use on transportation facilities. This should also consider impacts on land use that result from changing the social and/or economic structure of a community because of transportation system design or improvement. This research should develop a methodology to analyze these impacts in a quantitative and qualitative manner in order to integrate them in the planning process. Such integration should be within the four basic elements of the planning process: (a) formulation of goals, objectives, and policies; (b) analysis and development of alternatives; (c) evaluation of alternatives; and (d) implementation. It is worth adding that land use policies and controls should be examined and analyzed as to their effectiveness in achieving desired land use impacts and directing land use management. This research does not necessarily require mathematical modeling at this stage.

Priority: High

Suggested Budget: \$150,000 to \$200,000

Suggested Project Length: 18 months

Project No. : 3-11

Title: Manual of Performance and Operating Characteristics of Transit Modes

Research Statement

At present, there exists no comprehensive set of criteria and operating characteristics on different transportation modes. Such characteristics are needed for designing new systems or improving existing systems.

Research Proposed

This research should develop a manual on quantitative and qualitative characteristics of the different transit and paratransit modes. This would cover conventional rail, bus, and taxi systems as well as developing transit systems such as dial-a-ride and buses on exclusive rights-of-way. These characteristics should consider the design requirements of the facilities in terms of costs, rights-of-way, stations, vehicles, etc., and the operating characteristics of each system in terms of operating and maintenance costs, minimum highways, capacities, safety, comfort, speeds, energy consumption, communication requirements, demand density requirements, and level of service. It should also identify the most appropriate markets that each mode can serve.

Priority: High

Suggested Budget: \$75,000

Suggested Project Length: 9 months

Project No. : 3-12

Title: Determination of the Length of Time Required for Transportation Impacts to Occur

Research Statement

Experience with new transportation facilities and services has shown considerable variation in the length of time required for the impacts (direct and indirect) to occur. For instance, many freeways reach a relatively constant level of use within a few weeks of the opening. Land use patterns and travel habits of potential users may be affected long before the actual opening of the facility. Many rail transit systems have

similar impacts. However, bus service innovations generally require a longer period of time to establish a stable ridership pattern, and probably even longer to create relatively permanent changes in travel habits (such as the disposal of a second car). Experience also indicates that the availability of bus service concurrent with new residential development may have a more rapid effect on travel patterns.

However, no widely applicable data are available to predict the length of time required for transportation impacts to occur. This creates significant problems in predicting impacts and particularly in designing demonstration projects. Many apparently unsuccessful demonstrations may not have been sufficiently "permanent" to have full impact. Further, many such failures might have been avoided if the necessary lag time could have been predicted initially.

Research Proposed

The necessary research would involve (a) collection and compilation of documented experience with new facilities and demonstration projects and (b) design of a methodology for future use in measuring the time required for impacts to occur as a result of new facilities and demonstration projects.

Priority: High

Suggested Budget: \$50,000

Suggested Project Length: 12 months

Project No.: 4-1

Title: Planning and Design of Mass Transportation Services to Meet Mobility Needs of the Elderly and Handicapped

Research Statement

"It is hereby declared to be the National policy that elderly and handicapped persons have the same right as other persons to utilize mass transportation facilities and services; that special efforts shall be made in the planning and design of mass transportation facilities and services so that the availability to elderly and handicapped persons of mass transportation which they can effectively utilize will be assured; and that all Federal programs offering assistance in the field of mass transportation (including the programs under this Act) should contain provisions implementing this policy." (UMTA Act of 1970 as amended.)

In order to implement this national policy, we recognize the lack of knowledge, experience, and sensitivity to this unique problem. The 1971 White House Conference on Aging identified the lack of mobility by older Americans as a most critical need.

Although the UMTA Capital Grant Program guidelines call for priority to be given to elderly and handicapped persons, in actuality this service has not always been satisfactorily integrated into the total transportation system.

Research Proposed

This research proposal has several objectives: (a) to examine the legislative requirements of transportation for special groups; (b) to study and recommend improvements in the institutional coordination of funding sources for elderly and handicapped (DOT, HEW, OEO, HUD); (c) to study ways of coordinating transit services, funding, and equipment with the local and regional agencies of health, social, and rehabilitative programs; (d) to analyze the costs and benefits of providing special services versus services that are not separate but equal; and (e) to define manpower and labor considerations in providing transportation services to the elderly and handicapped.

Priority: Urgent (Transit systems and related government agencies have immediate need for the output from this research.)

Suggested Budget: \$100,000

Suggested Project Length: 8 months

Appropriate Funding Agency: Federal

Appropriate Research Agency: University and consultant (This research topic could be subdivided into 2 or more projects.)

Project No.: 4-2

Title: Study of the Merits and Problems of Combining Some Transit, School Transportation, and Goods Movement With Transit Vehicles

Research Statement

Peak-hour demands of the transit industry require the splitting of daily work hours for many operating employees. There is an urgent need for making the transit industry less labor-intensive and providing more efficient use of its labor force. There are indications that both transit labor and management would like to increase labor productivity and lessen the split-shift aspect so necessary at present. The ability to use transit equipment and personnel for the transportation of school children (which is being accomplished by charter in some cities) and to transport goods (of which there

are very limited examples at present) would materially aid transit efficiency. Many problems are involved in the proposed combination of these forms of transportation.

Research Proposed

1. What additional manpower requirements will be necessary if operating personnel were utilized for a continuous 8-hour work period?
2. Will the utilization of manpower, out of primary classification, be feasible if necessary related work is available at the time of manpower surplus?
3. Will the proliferation of individual union work rules require detailed amendments of labor contract?
4. Will the benefits of a varied daily work routine induce the willing cooperation of labor?
5. What are the wage rate considerations of dual classification of employees?

Priority: Urgent (Successful implementation of this project will have a high payoff.)

Suggested Budget: \$95,000

Suggested Project Length: 6 months

Appropriate Funding Agency: Federal

Appropriate Research Agency: Consultant

Project No.: 4-3

Title: Evaluation of the Purchase of New Transit Vehicles via the Consideration of New-Vehicle Quality as Measured Through Vehicle Maintenance Costs

Research Statement

The transit industry and UMTA held a series of high-level meetings to discuss the increasing problem of ensuring the purchase of a high-quality transit vehicle. The problem is directly related to the difficulty of properly evaluating truly responsive competitiveness between manufacturers of transit vehicles.

Purchasers of transit vehicles have had a dilemma resulting from (a) their inability to effectively utilize performance specifications in the bids for new transit vehicles because they are unable to determine at the time of delivery, or within the first year thereafter, whether the newly purchased vehicles really meet the performance specifications and (b) their inability to write stringent, specific technical specifications

(down to the last nut and bolt) because that type of specification writing will preclude the exercise of manufacturing ingenuity and technical know-how.

Because of this dilemma we have had "make-believe" competition in which two or more manufacturers' vehicles are declared to be competitive, and contracts are awarded on the basis of a low bid.

Research Proposed

This proposal suggests a means of creating real competition among responsible, responsive transit vehicle manufacturers and supplying the incentive necessary for the manufacturers to want to go beyond the performance or specific technical specifications and supply a truly reliable, cost-effective vehicle. The goals are to (a) establish authenticated maintenance costs for different types of transit vehicles in standard transit use and (b) to use these maintenance cost data as a means of measuring the relative quality of competitive transit vehicles.

Priority: Urgent (This information is needed immediately for obtaining quality transit vehicles.)

Suggested Budget: \$30,000

Suggested Project Length: 18 months

Appropriate Funding Agency: Federal

Appropriate Research Agency: American Transit Association

Project No.: 4-4

Title: Effectiveness of Federal and/or State Operating Subsidies for Urban Public Transportation

Research Statement

Urban public transportation properties have found it difficult if not impossible to provide adequate public transportation service to meet the public's needs for mobility with income derived from the fare box alone. Other sources of income are needed, among which are various locally raised taxes and/or funds raised by higher levels of government (federal and/or state) distributed to urban public transportation properties for operating subsidies. Questions have been raised as to the possible use of these externally available funds. The need exists to develop the means by which federal

and/or state operating subsidies can best be administered and monitored to maintain incentives for efficient, cost-effective transit service considering the socioeconomic benefits that may accrue to the community.

The research should consider questions related to the application of Section 13-C to operating subsidies. If 13-C is to be applicable to operating subsidies, is there a possibility of loss of effective control of transit by transit management and authorities?

Research Proposed

1. Identify measures of cost-effective utilization of funds to provide transit service.
2. Develop formulas or other means for determining the amount of federal and/or state funds to be allocated to the various transit properties for operating subsidies.
3. Develop administrative procedures for monitoring and ensuring the effective use of federal and/or state funds by urban public transit properties using measures developed in objective 1 to maintain incentives for efficient, cost-effective transit service.
4. Identify and evaluate the merits and problems inherent in application of Section 13-C to operating subsidies.

Priority: Urgent (There is an immediate need because of pending legislation.)

Suggested Budget: \$50,000

Suggested Project Length: 3 months

Appropriate Funding Agency: Federal

Appropriate Research Agency: Consultant

Project No.: 4-5

Title: Development of Effective Marketing Disciplines for Promotion of Use of Club Buses, Subscription Bus Service, Special Charter Group Trips, etc.

Research Statement

The energy crisis has acted as a catalyst for national efforts at reducing traffic congestion and air pollution, which in turn has stimulated interest in the use of club buses and similar special bus services. It is appropriate and timely, therefore, to identify the potential market, study, develop, and evaluate marketing techniques for

promotion and sale of specialized bus services.

Research Proposed

An assembly and review of successful marketing techniques is desirable. Development of pricing variables and their effect on transit ridership so as to determine pricing policies and promotional levels should be included with a set or sets of marketing strategies designed to meet the overall goal of increasing transit ridership and reducing air pollution and traffic congestion. Among objectives to be determined are (a) identification of market; (b) pricing policies; (c) utilization of transit vehicles and vehicle operators; (d) regulations; and (e) development of a manual of marketing advantages.

Priority: Urgent

Suggested Budget: \$20,000

Suggested Project Length: 4 months

Appropriate Funding Agency: Federal

Appropriate Research Agency: Consultant

Project No.: 4-6

Title: Effect of Car Pool Promotions on Transit

Research Statement

A national program to encourage and promote car pooling is under way. Many concerns are being expressed that car pooling promotion will have a detrimental impact on transit commuters. Others are hoping that there are in fact ways in which car pooling efforts can be used to encourage transit use. There is a need to examine the various ways in which car pooling is being implemented to determine whether some or many of the ways are detrimental and, if so, how they might be modified to lessen the effect or revise the effect to a beneficial one.

Research Proposed

1. Analyze existing regulations covering use of federal funds for car pool

demonstration projects as well as other funds regarding their adequacy in guarding against reducing transit use.

2. Review car pooling activities under way to determine extent of transit operator involvement.

3. Clarify activities under way as to which do and which do not have specific elements relating to transit.

4. Review details of the specific transit-related elements to determine their effectiveness.

5. Based on results from item 4 and other input from transit operators, develop a listing of all possible ways in which car pooling activities can be applied to impact transit in a positive way.

In the development of this work, the primary objective should be that of analyzing car pooling activity in conjunction with transit activity so as to reduce the amount of one-person-per-automobile travel.

Priority: Urgent (Energy crisis makes this a very high priority; its relationship to other transportation modes—i.e., the auto—is also important.)

Suggested Budget: \$80,000

Suggested Project Length: 8 months

Appropriate Funding Agency: Federal

Appropriate Research Agency: NCHRP

Project No.: 4-7

Title: Evaluation of Fare Packaging Procedures as a Tool for Inducing Transit Ridership and Reducing the Cost Associated With the Sale and Collection of Tickets

Research Statement

Various attempts at reducing the amount of "pain" associated with extracting a transit fare have been tried as a means of increasing transit ridership. However, little is known of the actual effect that packaging fares has had on the transit market. Such things as unlimited-ride monthly tickets, family tickets, stored-value tickets, and stored-ride tickets exist in many transit properties. Payroll deductions by employees have been used to purchase transit fares. Proposals have been made that would allow ticket purchases through credit cards or assignments against personal checking accounts. Ticket sales and fare collection procedures range from highly

sophisticated, high-capital-intensive automatic systems to low-capital-intensive, low-labor-intensive honor systems.

Little has been done to evaluate the various methods to determine their effect on ridership and system costs.

Research Proposed

1. Identify the fare packaging procedures presently in use by transit properties throughout the country.
2. Collect data on their effect on ridership and system costs brought about by the introduction of the various fare packages.
3. Test, through a demonstration, the acceptability of new procedures such as credit cards and prepaid or off-vehicle fare collection.

Priority: Urgent (Prospects are excellent for increasing transit ridership.)

Suggested Budget: \$65,000

Suggested Project Length: 6 months

Appropriate Funding Agency: Federal

Appropriate Research Agency: University or consultant

Project No.: 4-8

Title: Use of Retired and Part-Time Personnel as Transit Employees

Research Statement

The labor-management aspects of the use of either retired transit personnel or others as part-time transit drivers or other employees need study. Transit peak-hour need for more employees than are necessary during the remainder of the day makes this idea a means by which transit operations could be conducted in a more cost-effective manner.

Research Proposed

The research should include consideration of the following:

1. Equity to present employees regarding choice of job assignments ("picks" and seniority);
2. Consideration of ethnic variables;
3. Questions of adequate safety if elderly retired employees are performing a job involving the general public's safety;
4. Relation of maximum income that may be earned prior to loss of social security or other benefits;
5. Benefits to society and to the retired individual by giving him a meaningful job;
6. Advantages to management to reduce peak-hour need for drivers; and
7. Advantages to labor by reducing the need for as many split-shift personnel.

Priority: High

Suggested Budget: \$28,000

Suggested Project Length: 4 months

Appropriate Funding Agency: Federal

Appropriate Research Agency: University and consultant

Project No.: 4-9

Title: Human Resource and Development Needs for Expanding Transit Services

Research Statement

The past two decades of general decline have resulted in limited managerial expertise available within the urban mass transit industry. Also, the greatest concentration of this expertise is in fixed-route systems. To fully integrate new activities, additional managerial personnel with varied skills will be required. In addition, special training programs will be needed to acquaint traditional transit labor with new duties.

Research Proposed

Research on managerial manpower should include the following activities:

1. What new organizational positions (i.e., job titles) are needed to set up and administer these new activities? Where in the organization should these new positions be placed? What should be included in each job description? What should be included

in each job specification?

2. How are these new positions to be staffed? If internally, what specific job specification deficiencies are present and how are these deficiencies (training needs) to be overcome? If externally, how should the transit system locate, recruit, and select the best possible personnel?

Research on blue-collar training should include the following activities:

1. Identification of specific new duties, their degree of difficulty, and anticipated problems associated with their performance.

2. Analysis of alternative teaching techniques for acquainting labor with these specific new duties, including lectures, vestibule training, and on-the-job training procedures with an outline of major work elements.

3. Evaluation of adopted training programs for continual refining of blue-collar training. Maximum opportunity should be provided for operative employee input to this evaluation process as early in the program as possible.

Priority: Urgent (Middle-management training is a continuing need.)

Suggested Project Length: 12 months

Appropriate Funding Agency: Federal

Appropriate Research Agency: University and consultant

Project No.: 5-1

Title: Measuring the Quality of Public Transportation Service

Research Statement

Level of service may be defined as the interpretation of the measurements of those public transportation system attributes that affect the quality of service provided as perceived by the individual. A public transportation system is considered to have value to individuals in their role as transportation system users and in the set of activities that can be consumed as a consequence of transportation linkages. The users' perceptions of this system may change as measured by such factors as travel time, accessibility, reliability, comfort, and convenience. If these factors are positive ones, a high level of service may be perceived by the users, resulting in a high level of satisfaction with the system.

Determinations of levels of service are made by (a) choosing those public transportation system attributes that affect users in terms of needs fulfillment through the linkage of people and desired activities and in terms of the quality of the linkages

themselves; (b) measuring these attributes; and (c) interpreting those measurements. These determinations do not include all attributes that affect users' perceptions of quality of service. The measurements of these attributes have not all been quantified. The need exists for developing both a determination of levels of service and a methodology for utilizing these determinations for evaluating urban public transportation systems.

Research Proposed

To develop a meaningful methodology or framework for measuring public transportation levels of service and to relate these measurements to the users' perceptions of quality of service, the following objectives need to be met:

1. To thoroughly review the literature of ongoing and past research to gain a working knowledge of the state of the art of levels of service determinations;
2. To develop a determination of levels of service that relates the measurements of the systems' attributes and the value derived by consumers; and
3. To develop a methodology for utilization of this determination of value of service quality to consumers in the evaluation of urban public transportation systems.

Priority: High

Suggested Budget: \$300,000

Suggested Project Length: 4 years

Appropriate Funding Agency: Federal

Project No.: 5-2

Title: Identification of Public Transportation Consumer Groups

Research Statement

Public transportation constituencies or group memberships are of interest to planners, operators, and legislators. Each community has a group structure related to transportation. In the determination of this structure attention should be given to the following groupings:

1. Statistical aggregations of individuals by demographic characteristics, such as trip purposes;
2. Subcultural groups where differences are found in the life styles of individuals,

such as ethnic groups; and

3. Formal associations where individuals are intentionally organized into voluntary clubs or associations; specific transit-related associations include car and bus pools and transportation co-ops.

In the past, emphasis has been given to statistical aggregations. This overlooks the fact that users and potential users are caught up in particular life styles or formal associations that are related to transportation requirements. These groupings are related to the desires of users and can provide a useful framework to determine transportation demand. For instance, a formal association group could organize a transit mode to meet a group purpose. Research is needed to identify and describe groups within this framework that make identifiable transportation demands and to understand the differences in transportation service requirements among the various groups.

Research Proposed

The overall objective of this research is the development of guidelines for the determination of group membership categories (transportation constituencies) for which transportation requirements need to be determined. Specific objectives (or tasks) to accomplish this objective are as follows:

1. Conceptualize consumer group structure as related to transportation demand.
2. Identify the present ridership characteristics of each group and compare the indicated group structure with the conceptualized group structure.
3. Identify factors that define desired or acceptable levels of transportation service for each of the groups.
4. Develop measures of transportation service objectives relevant to each consumer group.
5. Prepare guidelines for use by planners, operators, and legislators.

Priority: High

Suggested Budget: \$150,000

Suggested Project Length: 2 years

Appropriate Funding Agency: Federal

Appropriate Research Agency: Consultant or university

Project No. : 5-3

Title: Monitoring and Evaluation of Public Transportation Systems

Research Statement

The decision to adopt a particular public transportation alternative is based on a favorable evaluation of its dimensions of benefit as compared to its dimensions of cost. It is important to realize that where this decision is made it is based on anticipated consequences that may or may not be actually achieved. The reasons for this discrepancy between anticipation and actuality include (a) the lack of knowledge concerning impact relationships; (b) the dependency on identification of relevant variables and their measurement, which introduces specification and measurement error; (c) the forecasting error concerning future levels of variables; and (d) the lack of control of significant factors affecting transportation system performance (e.g., population growth, development patterns, wages, and price levels).

Consequently, it is important to monitor actual system performance over time and to consider system modifications where this performance fails to achieve desirable levels of effectiveness. This monitoring and consideration of modifications constitutes a control mechanism based on updated information and reevaluation of system consequences.

Research Proposed

The specific tasks to be dealt with in the research are as follows:

1. To develop performance monitoring strategies consistent with a set of quantifiable transportation objectives. The various strategies would include considerations of measurement techniques, sample size, and frequency of sampling.
2. To establish criteria for evaluating alternative monitoring strategies.
3. To test the strategies by application to operational transit systems.
4. To develop guidelines for transit systems monitoring based on study findings and conclusions.

Priority: High

Project No. : 5-4

Title: Translation of the Mobility Requirements of User Groups Into Specific Transportation Service Characteristics

Research Statement

There has long been a disparity between the perceived needs for mobility among persons who desire mobility and the recognition of those perceived needs by those charged with the planning and provision of public transportation. Different transportation desires can probably be answered by a variety of public transportation submodes and/or public transportation service types. There are potential applications for all conceivable forms of public transportation, from high-speed rail through arterial bus to individual taxi, in various operational modes such as standard transit mode, "elevator" mode, or demand mode. One submode and/or service type may answer the perceived needs more effectively, more realistically, or more efficiently than another. It is the matching of these mobility desires with specific service modes and characteristics, including fees, vehicles, convenience measures, etc., that is the desired end product of this research project.

Research Proposed

The first objective of this project would be to determine how each of the various user groups that may be identified can be served most effectively—that is, in terms of providing the best possible answer to each group's own movement problem. The requirement is to bridge the gap between dimensions of value to consumers (access to health care, visit friends, etc.) and dimensions of transportation service that are meaningful and controllable by transportation developers (routings, fares, etc.).

Second, the most realistic approach would be sought, in terms of available transportation resources and technologies.

Third, the most cost-effective approach would be developed—one that would provide the desired mobility at the lowest possible cost, both to individuals and to the community.

Finally, a synthesis of these three approaches would be attempted in order to determine the most rational overall approach to the solution of the mobility problem for each user group.

When such a synthesis concerning each group has been reached, guidelines would be prepared for the use of interested bodies, with the purpose of reducing the amount of searching among service types that accompanies almost every major transportation study. It might also lead to the eventual development of an acceptable submodal choice model and assignment technique.

Priority: High

Project No.: 5-5

Title: Potential for Diversion of Automobile Commuters to Public Transportation

Research Statement

The critical challenge to the total public transportation system is to find how to attract commuters who now drive to work in the CBD or other major activity centers (e.g., airports, universities, factories) into a public transportation mode. This can be done by various approaches to improving the service characteristics of current systems or by providing new systems (typically of the paratransit variety) more adapted to the commuters' needs. This research project is intended to provide guidance to public transportation managers and developers to better enable them to adapt their systems to these potential users.

Research Proposed

1. By a search of the literature and by examination of the experience of public transportation systems, identify the information available on the effects of various performance changes (e.g., fare reduction, travel-time reduction) on diversion of auto commuters to public transportation.
2. On the basis of the available information, identify the most attractive means of diverting auto commuters to public transportation.
3. Design and conduct the critical experiments to test and validate the relationships (suggested in 2 above) between system performance characteristics and auto commuter diversion.

Priority: High

Project No.: 5-6

Title: Information System Requirements of Transportation System Consequences

Research Statement

The evaluation of transportation system consequences is dependent on two factors: (a) the existence of a data set providing evaluation input information with respect to all relevant dimensions of the decision-making situation; and (b) the presentation of these data in formats that are meaningful and simple to manipulate, given various levels of decision-making and various characteristics of decision-makers.

Typically, information needs vary considerably, depending on whether the user of this information is a political decision-maker, a transportation professional, or a funding agency. Since each of these personalities may be interested in a given

transportation investment decision, the information set should be capable of being presented (a) at various levels of aggregation, (b) at various levels of technical complexity, and (c) in various output formats.

Research Proposed

The research would consist of the following tasks:

1. Identify input data requirements compatible with various decision-maker characteristics. This component would deal with format types, methods of display, and useful levels of detail rather than explicitly identifying all relevant information for large numbers of decision-making situations.
2. Consider effective means of dealing with problems of information overload as the amount of available information increases.
3. Develop techniques that permit interaction between decision-makers and information displayed. This capability would permit rapid feedback of consequences of system changes, sensitivity analyses of input parameters, special summaries, etc.
4. Develop information system performance measures for factors such as flexibility, simplicity, response time, and cost.
5. Experiment and document findings concerning the techniques developed.

Priority: High

Project No.: 5-7

Title: Assessing Benefits of a Public Transportation System for Users and the Community at Large

Research Statement

The user of a transit system receives benefits from the use he makes of it. The community also receives benefits. The question here is how to determine the range and amount of benefits received by the user and the larger community. Such information can be used by planners and operators in designing and operating systems to maximize social benefits. Benefits may include both dollar and non-dollar benefits. Whereas dollar benefits can be directly compared to transit costs, non-dollar benefits are more difficult to evaluate. The latter require that a way of presentation be developed so that they can be used by planners, operators, and political decision-makers to evaluate system alternatives.

Research Proposed

Identify public transportation system benefits. Propose a framework or methodology for presenting these benefits in such a way that they may be used to evaluate a

transit system. Specific tasks required to accomplish this are as follows:

1. Define what a user benefit is and what a community benefit is and show their direct linkage to the public transportation system.
2. Develop measures of each benefit defined and test these measures for a sample of systems and communities.
3. Develop a consistent and usable framework for presenting results of benefit analysis to planners, operators, and other transit decision-makers.

Priority: Medium

Project No.: 5-8

Title: Demand Elasticities of User Groups as Related to Service Attributes

Research Statement

What are elasticities of demand with respect to transportation service attributes such as price, travel time, convenience, and safety for various user groups?

Research Proposed

1. After identifying various user classifications according to their different transportation requirements and establishing a set of linkages between these requirements and transportation (and therefore transit) service characteristics, research should be addressed to measuring the relative effect of varying different service characteristics. Attention should be given to isolating these effects by different user groups and by different individual service characteristics and different combinations of service characteristics. Attention should also be given to documenting other activities or occurrences that could have an effect on measuring the effects.

2. Many of these types of studies have already been made. Further data on effects versus changes in characteristics exist in many places but have not yet been subject to analysis in an attempt to measure effects. Research should be designed to document what has been done already and then to fill in the gaps in this research aimed at more fully explaining effects on different user groups and isolating which characteristic has which effect.

3. In attempting to measure the effect of a change in characteristics of a transportation service, some research should be addressed to measuring the lack of effects on various user groups. In other words, research should be designed to solicit reactions from those who were "moved" by the change as well as from those who were unmoved.

4. Another area of research is to attempt to define or quantify the gap between anticipated reaction to or satisfaction with a transit service characteristic and the actual reaction as evidenced by changed use of the system. This might be accomplished by attitudinal surveys made prior to a change and after a change to measure

the difference between how the user said he would react and how he actually reacted.

Priority: Medium

Project No. : 5-9

Title: Measurement of Convenience for Auto Access

Research Statement

In assessing the quality of service or service characteristics of transit service, there is always a comparison made to the auto with regard to accessibility; i.e., if auto ownership is assumed, there is little or no walking distance or waiting time involved in its use. There has also been a distinct trend toward designing transit systems that require or are enhanced by park-ride provisions where the entire trip is not made by transit. There has been little effort directed toward determining and/or measuring the relative advantages of transit systems that use auto access as a characteristic. Is a system that attracts more passengers but requires all of them to use auto access any better or worse than one that attracts less passengers but requires none to use auto access?

Research Proposed

Research should be designed to solicit information from potential users as to their attitudes or degree of satisfaction toward use of autos for none of the trip, part of the trip, or all of the trip. Before-and-after studies should be made where parking facilities are made newly available as to the changed trip characteristics of the users of these parking facilities and their degree of satisfaction with the new mode versus their previous mode.

Priority: Medium

Project No.: 6-1

Title: Effects of the Absence or Decline of Scheduled Public Transportation Services on Those Who Are Expected to Be Dependent on Transit

Research Statement

A number of small and medium-sized cities in the United States have no scheduled transit services. Either their former transit system has gone out of business or is on strike or the city never had scheduled transit service.

Much has been said about the dilemma of the transit-dependent, those who cannot or do not drive (the elderly, the young, the poor, the handicapped, and the second worker in a household). But little has been done to measure the actual effects of the absence of public transportation service.

We do not know, with any degree of certainty, how these people travel, if and what they substitute for transit service, what their expenditure and activity patterns are, and how their lives compare with similar groups of people who are served by reasonably good transit service.

Research Proposed

Evaluate the effects of the absence or decline of scheduled public transportation services on those who are expected to be transit-dependent (a) in cities that have not had scheduled transit service for a number of years (look first at the largest cities, such as Port Arthur, Texas, and other Southwest cities); (b) in cities in which the transit operation has recently gone out of business (or is about to go out of business); and (c) during strikes, in terms of the number and types of trips that the people make, expenditures for transportation, income, employment, levels of other activities, and substitute solution for trip-making by before-and-after comparisons or comparisons with control groups in cities that have good public transportation service.

Suggested Budget: \$200,000

Suggested Project Length: 18 months

Project No.: 6-2

Title: Benefits of Transforming Institutional Constraints to Incentives for Innovative Transit Service

Research Statement

Efforts to develop new systems for public transportation (PTS)—e.g., jitneys, van pools, and paratransit—in the last 10 years have been severely hampered by institutional constraints in a number of areas, including governmental regulation, franchising, labor work rules, and restrictive legislation.

There is a need to evaluate the costs of such restrictions in terms of PTS operation. The historical context and present interests perpetuating undue restrictions should be clarified and discussed with the purpose of revising them to provide incentives for developing varieties of PTS.

Research Proposed

1. Survey the 50 states to ascertain and describe the variety of institutional constraints limiting implementation of PTS. Interview groups indicated by local, regional, and state regulatory officials, labor unions, PTS management, and elected officials.
2. Explore costs and benefits associated with forced compliance to restricted and outdated regulatory constraints in each category in the first phase.
3. Develop strategies for revising such constraints to develop incentives for improving service delivery and survey the response of relevant groups to such revisions. Recommend strategies for transforming constraints to incentives.

Suggested Budget: \$100,000

Suggested Project Length: 18 months

Project No.: 6-3

Title: Economic Impact of Labor Practices on Transit Efficiency and the Implications of Current Trends

Research Statement

There are a number of transit operations that have a potentiality for improvements in terms of increased productivity and/or reduced costs but that are constrained by labor practices (including wages and fringe benefits) specified by union contracts. For example, systems having severe peak-hour loads could reduce costs if more part-time

labor were used during these hours or if they could tailor split shifts to the peaks. In addition, costs could be reduced if regular operators could be used for alternative jobs during off-peak hours. Although there are many good reasons for protecting the rights of labor and maximizing employment, there are also obligations to the transit users who must pay high fares or taxpayers who must pay high taxes. What is needed in this research is the development of the costs and consequences of these labor practices irrespective of whether they are "fair" or "unfair" to labor, management, or the public.

Research Proposed

1. Identify areas where operating costs and efficiency are constrained by labor practices.
2. Identify how operations would work under "ideal" labor conditions.
3. Compare the relative cost and efficiency of the labor-constrained operations versus the unconstrained operations.

Priority: High (Labor cost is, by far, the major proportion of operation and maintenance costs. Therefore, if there are to be any major gains in cost reduction and efficiency, consideration must be given to the labor component. Moreover, capital improvements that do not replace labor will have little impact on costs unless they employ changes in labor practices. If cost minimization and efficiency improvements are high priority, then a study of this nature is essential even though it may be distasteful to labor.)

Suggested Budget: \$80,000

Suggested Project Length: 1 year

Project No.: 6-4

Title: Improved Techniques for Identifying and Serving Transit Market Requirements

Research Statement

Increasing involvement by elected officials in transit operations has frequently forced transit management to provide services that would not be warranted under traditional evaluation techniques. The transit manager needs to be able to identify, anticipate, evaluate, and meet a community's priority transit service requirements before they become matters of political consequence.

Traditional transit marketing programs have not fully exploited the potential market. Techniques are needed that will identify user and potential-user subgroups, foster active subgroup participation in transit decision-making, define service requirements for each subgroup, and induce transit management to respond to priority service requirements.

The research task could be divided into a number of separate projects, each aimed at a specific market subgroup.

Research Proposed

Develop techniques for the following:

1. Foster public participation in transit decision-making
 - a. Organize market segments for effective participation
 - b. Encourage user initiative
 - c. Involve market segments in analysis and evaluation of service requirements
 - d. Institutionalize user feedback into the operation's decision-making process
2. Define service requirements of each market segment
 - a. Identify requirements of elderly, handicapped, other disadvantaged, commuters, potential users, and other market segments
 - b. Quantify service desires and service needs
 - c. Analyze service strategies versus cost trade-offs and comparisons
 - d. Define process for prioritizing competing requirements
3. Propose incentives to induce transit management to respond to priority service requirements
4. Propose incentives to increase transit use by market segment
5. Identify and program a demonstration project to assess the suitability of the techniques enumerated above

Suggested Budget: \$120,000

Suggested Project Length: 2 years

Project No.: 6-5

Title: Benefits of the Transit System Stratified by City Size (Not Limited to Dollar Measures)

Research Statement

Many communities are faced with the necessity of making decisions regarding the public takeover of private transit systems, the funding of operating deficits, and/or the expansion and improvement of systems that are losing money. Further, there is a need to determine transit's place in the balancing of local transportation modes.

Few, if any, of these cities or regions have meaningful information readily available from which to make such decisions.

The benefits of a transit system to the communities it serves need to be qualified and quantified. This information should be stratified by city size so that it may

properly be used for comparative purposes. The measurement of benefits should not be limited to dollar values so as not to overlook any of transit's advantages to the community—its businesses, industries, and people.

A study outline that will make it possible for any community to readily gather and evaluate such information is necessary. The resulting material is important for comparing the area's transportation network with transportation networks of similar areas, for the development and implementation of a balanced transportation plan, and to aid in the decision-making process of the policy-makers regarding existing or planned transportation projects.

Research Proposed

1. Develop a list of community and user benefits from which any region or municipality can develop a report.
 - a. Review available data.
 - b. Develop related information not readily available.
 - c. Analyze material obtained.
2. Develop formulas to establish cost/benefit ratios where dollar values exist.
3. Initiate a demonstration project to test the validity of the formulas. This project should be conducted in a community or region concerned with the problem and facing the need to arrive at a decision.

Priority: Urgent (Because this problem concerns many areas and most frequently requires the heavy expenditures of tax moneys, it should be considered as top priority.)

Suggested Budget: \$75,000

Suggested Project Length: 8 months

Project No.: 6-6

Title: Advantages of Scheduling Activities in Which Transit Users Engage to Be More Compatible With Efficient Transit Operations

Research Statement

One of the transit demand characteristics that makes it difficult to operate economically viable public transportation systems is the peaking of demand over a short period of time each day. If off-peak demand could be increased and peak-hour demand decreased, operations could be made more effective. Attempts to stagger work shifts have provided only limited improvements. Recent increases in the number of new systems, many of which are small, labor-intensive, and serve special groups (such

as the elderly), provide new opportunities to increase the viability of these systems by coordinating the scheduling of activities, such as appointments for health-care and recreation-center activities, to even out the hourly distribution of demand.

Little is known about the operating principles that influence scheduling of activities and how consistent they are from city to city. Thus, there is a need to define these guiding principles and explore the economic benefits from rearranging events and activities for the mutual benefit of the system and the activity sponsor.

Research Proposed

1. Select activities that generate significant portions of transit and potential transit trips by surveying literature on activities of transit user groups and interviewing specialists in life styles and activities.

2. Define hour-by-hour variation in attendance and use of activities. Relate use to operating principles determined by interviewing selected agencies in five representative cities.

3. For a variety of public transportation systems, including dial-a-ride, fixed-route bus, and similar labor-intensive systems, examine typical daily ridership and estimate magnitudes of benefits attainable by redistributing hourly demand.

4. Survey the attitudes of activity-scheduling decision-makers to appraise probabilities of achieving benefits in item 3.

5. Develop guidances for integrating a variety of activities and associated groups (elderly seeking health care or youth going to recreation centers) into a workable schedule compatible with operating principles of the transit and activity managers.

Priority: High

Suggested Budget: \$80,000

Suggested Project Length: 1 year

Project No.: 6-7

Title: Transit Alternatives for Non-CBD Travel

Research Statement

In most U.S. cities today, the configuration of transit routes and the consumer markets served by them are a result of historical erosion of transit services effected by the economic and regulatory constraints under which they have operated in the past. The end result is that most of the services that have survived are those that display conventional economic viability, serve easily determined markets, clearly assist in reducing investment for alternative modes, and have influential political support.

Thus, the overwhelming percentage of transit service is now provided on routes oriented toward CBD travel. The full usefulness of expanded transit can only be achieved by determining the nature and dimensions of other markets, comparing alternative transit modes to serve these markets, and ascertaining any barriers to implementing such expansions. The transit modes to be evaluated are to include labor-intensive and capital-intensive systems and combinations thereof.

Research Proposed

1. Identify trip characteristics and develop associated codings to enable data to be prepared that describe and quantify market segments in a manner suitable for detailed transit evaluation. These would include such characteristics as the range of trip distances involved, frequency, time patterns, and constraints.
2. Identify the various transit and paratransit modes that will be tested to serve the markets identified.
3. Using one or more cities, collect data on various identifiable market segments.
4. Apply the various modes to the various market segments to determine appropriateness.
5. Ascertain any barriers to the implementation of a particular mode to a particular market segment.
6. Determine whether those markets appropriate for a common mode can be jointly served by that mode.
7. Where it is concluded that different modes are required for different markets, determine the feasibility of linking such modes into a total interactive transit system.
8. Ascertain any barriers to the implementation of particular modes on a linked or total-system basis.
9. Establish cost comparisons of those various total-system combinations perceived to be operationally viable in expanding the non-CBD transit market.
10. Investigate the estimates of the percentages of the various market segments that could be expected to utilize the transit alternatives proposed. Aggregate such estimates in order to show the total loadings that could be expected on an expanded transit system.

Suggested Budget: \$400,000

Suggested Project Length: 2 years

Project No. : 6-8

Title: Development of Measures and Standards to Assist Definitions of Travel Service Levels

Research Statement

Transit managers and planners, in the development of alternative solutions to travel problems, are required to make intuitive judgments concerning how patrons trade off various transit service characteristics. For example, decisions about stop spacing often require a knowledge of the relative importance of time spent on the transit vehicle versus time spent walking to the stop. Similar decisions involving line splitting often require knowledge about whether patrons prefer shorter headways or shorter walking distances. These decisions become especially important on more lightly traveled bus lines during off-peak periods when an acceptable level of service must be prescribed that is usually beyond that required on the basis of capacity standards.

Several "standards" are often used, such as 1 $\frac{1}{4}$ -mile walking distances or 30-minute headways but the origin of such measures is unknown. Little factual information exists on what constitutes a minimum service level under various conditions. Quantitative data are required to assist management in this regard.

Research Proposed

A review of present practices and standards relative to acceptable service levels is needed, along with the identification of those measures and service characteristics to which patrons may be sensitive and which, in the aggregate, constitute the "level of service". Factual data on passenger preferences are required to establish service standards under varying conditions.

Some service characteristics believed to be important and that should be quantitatively investigated included the following:

1. Acceptable walking distances to transit stops—weather effects, effect of walking environment, lighting;
2. Acceptable waiting time for transit—shelters, lighting, socioeconomic character of the area around the transit stop;
3. Acceptable service reliability—acceptability of late arrivals, acceptability of early arrivals, effect of headway; and
4. Acceptable travel times—trip purpose, city size, and others.

The product of the investigation should include quantitative guidelines or standards for each characteristic for varying conditions.

Priority: Urgent (Decisions are being made daily that involve and require the information to be developed here. The product of this research constitutes the basic input to the most fundamental decisions concerning transit service.)

Suggested Budget: \$130,000

Suggested Project Length: 15 months

Project No.: 6-9

Title: Development of Aggregate Measures Providing Comparison Between Cities of Levels of Services

Research Statement

Until recently most local transit systems were operated by private interests as "for profit" enterprises. Management decisions concerning routes, schedules, equipment, maintenance, and administration could thus be made within the basic profit maximization objective. However, many transit systems are now publically owned and operated at current levels only through the input of public funds generated externally, often from local and state tax revenues. Under such conditions decisions concerning how much service versus how much external financing are more complex. Local officials have expressed the need for service standards that would guide such decisions. While such standards may in the future be possible, it would be helpful in the interim to have knowledge of what level of service is currently being provided under varying conditions so that in any particular instance a city or community can evaluate how they compare with others.

Research Proposed

Identification is required of those aggregated level-of-service measures that could be used for comparison of service levels. Consideration should be given to such measures as bus-miles per capita, seat-miles per capita, route-miles per capita, and bus-miles per square mile. Measures of system financial position also should be determined, such as dollars per square mile per year.

Cities vary as to their basic propensity for generating transit patronage. For example, large cities, dense cities, and cities with large CBDs might generate more transit travel than others. These aggregate service tendencies and special characteristics must be identified along with appropriate measures so that service provided may be compared with cities of a similar type. These same characteristics should be used to explain differences of service found in different areas within cities as well.

The results will permit (for example) a city or community within a city considering a change in its public support to transit to see where it ranks presently with regard to other cities or communities with similar characteristics.

Priority: High

Suggested Budget: \$90,000

Suggested Project Length: 12 months

Project No. : 6-10

Title: Identification and Development of Standard Definitions and Techniques for Collecting Data Required for Evaluation and Performance Measures

Research Statement

Aside from the problem of identifying useful transit evaluation and performance measures, there are the additional problems of providing (a) accurate definitions of the variables in the measures and (b) uniform and/or acceptable methods of collecting data on the variables. For example, the term "transit revenue per passenger-mile" requires several variables that depend on the formula used in its calculation: transit revenue, number of passenger trips, and passenger trip length. To obtain uniformity in the measurement concept, there must be agreement in the definitions used. Moreover, once the definitions are agreed on, the data-collection technique for each variable should also be standard within acceptable limits. The latter techniques would include but not be limited to (a) sample design and sample size, (b) sample confidence levels and intervals, (c) measurement technique, and (d) frequency of measurement.

It is significant that neither the definitions nor the data-collection techniques for this important measure are uniform in the transit industry. Therefore, comparisons among systems are (technically) invalid. This same situation applies to many of the variables in the more common evaluation measures, e.g., number of passengers, bus-miles, route-miles, and peak-hour ridership.

Research Proposed

1. Identify key evaluation and performance measures (from other studies).
2. Develop uniform formulas for calculating the measures (several alternatives may be developed).
3. Develop uniform definitions of the variables in each formula (other studies on definitions should be used).
4. Develop uniform measurement and sampling techniques for obtaining data on each variable.

Priority: Urgent (Criteria for allocation of capital grants and operating assistance are being developed by UMTA. The FARE project has addressed uniformity of the financial aspects of transit, but it only scratched the surface with respect to operating data. Until such uniformity exists, comparative analyses among systems and the measurements used in the allocation of resources will be suspect.)

Suggested Budget: \$80,000

Suggested Project Length: 9 months

Project No. : 6-11

Title: Development of Standardized Benefit Measures for Transit Evaluation

Research Statement

Justification of expenditures of public funds for either annual operating subsidies or large investments in new capital-intensive systems depends ultimately on a showing that benefits resulting from such expenditures exceed the expenditures. Federal and state funding administrators are required because of funding limitations to make decisions between alternative projects, again ultimately by reckoning that some projects will generate benefits, compared to costs, in excess of others.

However, although the cost calculation is relatively straightforward, the assessment of benefits requires the measurement of attributes that may defy reduction to monetary units or perhaps even quantifications in any form. Doubtless it will be difficult to gain consensus on an optimum benefits assessment methodology. It is important that a standardized method be employed using common techniques, units, and attributes so that comparisons between projects can be made.

Research Proposed

A review of classes of benefits is required including economic, social, accessibility, and environmental benefits and identification of those items within each class that are likely to prove significant. A literature review will be performed to determine the best methods for measuring each benefit item. The benefits assessment thus derived must be integrated into several evaluation frameworks, such as benefit-cost ratio and economic rate of return, or to a combination procedure such as a goals-achievement matrix. However, those measures capable of reduction to monetary measures should be specified in appropriate units.

The methodology thus derived should be tested by application to (a) benefits of an existing transit operation and (b) benefits of a large-scale contemplated transit improvement.

Suggested Budget: \$200,000

Suggested Project Length: 14 months

Project No.: 6-12

Title: Public Transportation Versus Other Community Services and Facilities

Research Statement

As an increasing number of transit operations are incurring deficits and those deficits are growing, local and regional agencies must make critical resource allocation decisions as to how much money transit should receive relative to other public-service programs. The increased role of revenue sharing is also causing more emphasis to be directed toward the resource-allocation process.

Research Proposed

Quantifiable indicators need to be developed that illustrate typical public-service costs that could be compared with transit costs. Public-service activities might include, but not be limited to, facilitation of auto movement, police and fire protection, education, sanitation, libraries, and recreation facilities. The indicators would be per capita, per family, per user, per unit of service, etc. A number of representative cities would then be selected to analyze these indicators. The result would be a summary of such information for use by local and regional communities.

Priority: High

Suggested Budget: \$50,000

Suggested Project Length: 12 man-months

Project No.: 6-13

Title: Classification of Alternative Service Concepts and Identification of Major Similarities and Differences in Layman's Terms

Research Statement

A number of terms such as rail, bus, PRT, and dial-a-ride are often used to describe different services. These terms have different meanings to different people. Furthermore, even if consistent frames of reference are used, there are many variations of a basic concept. For example, bus can include subscription bus, minibus, fixed-route and scheduled bus, express bus, exclusive bus, articulated bus, etc. Often a similar service can be provided by difficult modal concepts. For example,

although dial-a-bus and exclusive-lane bus might both be considered "bus", dial-a-bus is closer to taxis and exclusive-lane bus is closer to light rail. Thus, we should think basically in terms of service concepts, how these service concepts differ, and how they can be realized using existing and new technologies.

Research Proposed

The service concepts would be developed. Each would be described in terms of a few easily understood parameters. Such parameters might include capacity, installation time, cost (capital and operating), and flexibility with respect to time and space. Existing and proposed new technologies would then be catalogued under the classification system. The system must be such that it can be easily understood by the layman. It is not necessary that current modally oriented technology be utilized. In fact, one objective should be to see whether current modal differentiations tend to clarify or confuse service and system differentiation.

Priority: Urgent (For priority service, all other modes should build on these findings.)

Suggested Budget: \$175,000

Suggested Project Length: 18 man-months

Project No.: 6-14

Title: Analysis of the Relationship Between Transit System Evaluation Measures and the Variables Being Controlled That Affect the Evaluation Measures

Research Statement

Measures used to evaluate the effects or performance of a transit system should be related to specific transit system variables that can be controlled by system operators. For example, a system's performance with respect to safety may be evaluated by calculating the number of deaths or injuries per vehicle-mile. However, the control variables that may have an impact on this measure may be number of driver safety training hours, door opening and closing speed on vehicles, station or bus stop dwell time, measured jerk rate, and so on. Similarly, the control variables that reduce the number of robberies, muggings, and rapes on system property and vehicles may be the number of security guards patrolling stations and vehicles, the number of radio-equipped vehicles, and the number of vehicles and stations with TV surveillance.

Research Proposed

1. Identify the evaluation measures (from other studies and by agreement).
2. Identify candidate control variables that relate to the evaluation measures.
3. Collect system data on the evaluation measures and control variables.
4. Perform theoretical and statistical analyses of the relationship between the evaluation measures and control variables.

Priority: Urgent (This study clearly relates to clarifying operating policies with respect to variables that operators can control. Unless there is a clear-cut relationship of the operating variables to the evaluation measures, then the latter may be useless in policy decisions.)

Suggested Budget: \$200,000

Suggested Project Length: 2 years

Project No.: 6-15

Title: Development of Guidelines for Methodology and Research Design for the Evaluation of Transit Service Demonstrations and Trials of Innovations

Research Statement

Numerous innovations in transit services are tried throughout the country, but much of what might have been learned is lost or cannot be disseminated because (a) the appropriate data were not collected at the appropriate time, (b) there was no research design, (c) the methods of data collection on evaluation were of dubious validity, or (d) information was assembled in such a way that it is not comparable with that from demonstrations and trials conducted elsewhere.

Research Proposed

1. Develop research designs that can be used for (a) formal trial and demonstration projects of public transportation service and (b) routine or major service innovations or changes in fare level on the part of transit operations.
2. Determine and specify data that should be collected for demonstrations and trials of service innovations.
3. Determine and specify how and when data should be collected.
4. Develop methodology for assessing and evaluating the data assembled.
5. Determine how frequently changes can be made during a demonstration project. One desires to obtain information in the shortest period of time, but if changes are made too frequently it is difficult to determine which change resulted in which impacts.

6. Determine what factors should be considered in selecting a site for a demonstration project. Should the site be as representative as possible or should it be chosen to maximize the probability of success?

7. Categorize the time delay in impact realization. Some changes such as latent demand may occur fairly frequently. Other changes such as a decrease in auto ownership take a longer time, and still other changes such as land use or urban structure alterations take an even longer period.

Priority: Urgent (This is a top-priority project that is needed as soon as possible.)

Suggested Budget: \$70,000

Suggested Project Length: 9 months

Part V
ADDENDA

CONFERENCE PARTICIPANTS

(Number in parentheses is the workshop
to which the individual was assigned.)

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