LOW COST TRANSPORTATION IMPROVEMENT ALTERNATIVES FOR MEDIUM-SIZED CITIES

THESIS FOR THE DEGREE OF M.U.P.

MICHIGAN STATE UNIVERSITY

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1976

ABSTRACT

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By

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Most cities are faced with the problem of improving peak hour transportation from suburban areas to major activity centers, e.g., the Central Business District, at the lowest possible cost consistent with the objectives of reduced traveltime, congestion, and cost to the user. Medium-sized cities (250,000 to one million population) are faced with the added problem of insufficient densities to justify major capital intensive solutions. For these cities in particular low cost improvements to the existing network are the only prudent alternative.

This thesis identifies relevant low cost improvement alternatives drawing from current transportation literature. It assesses the adequacy of each alternative separately and in terms of their complementary effectiveness. Following the assessment, alternative improvements are categorized and cross-classified against a range of criteria of effectiveness and the goals and objectives of a particular region. For the purposes of demonstrating how to construct an implementable system containing low cost improvements, this methodology is applied to the New Orleans region.

The major finding is that a region-wide system such as Park and

Ride can provide an adequate framework for low cost transportation in medium-sized cities with moderate levels of density and trip-making demand. Supplemented by such incentive measures as preferential treatment for high-occupancy vehicles, exclusive transit lanes, ramp metering and actuated signals, and such disincentive measures as high parking taxes and road user fees, a regional network of parking facilities and express buses can meet the basic requirements of peak hour travel at relatively low cost. The basic conclusion, however, is not that every medium-sized urban area should develop a Park and Ride system, but that urban areas can identify complementary transportation improvement alternatives, consistent with their peculiar problems and goals and objectives, and construct a workable plan or package of actions suitable for their particular urban context.

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A THESIS

Submitted to
Michigan State University
in partial fulfillment of the requirements
for the degree of

MASTER IN URBAN PLANNING

School of Urban Planning and Landscape Architecture

1976

ACKNOWLEDGEMENTS

The author wishes to express his appreciation to those individuals who have offered their encouragement and advice in the preparation of this manuscript. Special thanks are extended to the following: my wife, Susan; Professor Donn Anderson, thesis advisor; John Stone, transportation planner; and the planning staff at Curtis and Davis Architects and Planners in New Orleans.

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INTRODUCTION

The concerns of transportation planners and policy-makers have, in the past, centered on costly large-scale projects designed to improve urban mobility without substantially improving the efficiency of existing systems. This approach represented a continued growth policy with its corresponding increase in vehicle miles of travel. The results of such a policy are evident; as urban regions have become increasingly spread out, a dependency on the automobile has developed, resulting in continuous demand for more travel even as major freeways and other auto-oriented facilities are constructed to meet current deficiencies.

One solution to this dilemma is to reduce the necessity for regional travel, particularly for trips which are made during the peak hours, such as work trips. This solution represents a restructuring of urban growth patterns, with an increase in employment, cultural and governmental activities in suburban centers, and a decline in CBD activities.

A second solution is to maintain and possibly increase person trip levels between the suburban residential centers and the CBD without also increasing the number of vehicle miles traveled. This alternative is the more logical from the transportation planner's point of view, unless there is a policy aimed at drastically changing the pattern of metropolitan growth.

A major consideration is cost. The cost of freeway construction is enormous, even for municipal jurisdictions which do not face serious financial shortages. Such construction also runs the risk of being counterproductive in the long run if it results in substantial increases in vehicle travel. As a result, in recent years greater emphasis has been placed on the development and implementation of low-cost transportation system improvements. Implementing the least costly alternatives, however, is not sufficient unless the result is to also achieve the intended goals for transportation service improvement. While low cost is an important feature of these improvements, the most feasible alternatives must also meet the objectives of energy conservation, short implementation time, minimal institutional changes, public and political acceptance, reduced travel time, and other factors.

This thesis addresses the issue of low-cost transportation improvement alternatives and how they can complement each other to achieve the best overall results, particularly in meeting the needs of medium-sized cities (250,000 to 1 million).

First of all, a number of specific improvement actions will be discussed in terms of their individual advantages and disadvantages. Then, the individual actions will be grouped into general categories which will be interrelated and evaluated in terms of their ability to meet several important criteria. These criteria can be weighted to reflect the emphasis which the particular metropolitan area places on them. Finally, depending on the specificity of the region's goals and objectives, these policy guidelines can either determine which criteria are used to evaluate the transportation alternatives or serve as a final check on the preferred systems. When the goals of the region are very general and specific objectives are lacking, it is extremely difficult for the planner to find a sufficient basis for any alternative development and analysis. Therefore, it is extremely important to first achieve resolution of these goals and objectives by the decision-makers. After a set of "good" alternative improvements has been selected through the above process, concepts will be combined into workable and implementable systems. "Park and Ride" is a form of transportation service which is an implementable combination of several complementary improvements. Such a system may serve as the framework of future regionwide systems. "Park and Ride" will thus serve as a focal point for the discussion of general implementable systems. The New Orleans region will then serve as a case study showing how such a system can be planned and implemented for a particular region. "Low cost" is considered the over-riding consideration of the planned improvements to be balanced by the relative values of other system objectives. Finally, conclusions will be drawn as to the state-of-the-art of low-cost improvements, their application to other urban areas, and what the future holds for this type of approach to transportation planning.

The basic approach of the thesis is quite simple. Specific improvement measures are examined in terms of their individual merits and their collective purpose. The most advantageous elements are then cross-classified against the objectives of the community and the evaluation criteria most suitable in measuring the attainment of the objectives. The responsibility throughout this alternative evaluation process for adopting objectives and evaluation criteria is that of the public and their political representatives. It is the responsibility of political decision-makers to weigh the alternatives and make the necessary tradeoffs for selecting a plan of action. It is the responsibility of the planner to present the facts and reasonable alternative courses of action to the decision-maker.

While it is still considered necessary to use complicated mathematical models to generate and distribute trips throughout a metropolitan region, greater effort should be made to simplify the process of evaluating the information generated by these models. Planners should not contribute to the illusion that such evaluation is a highly technical and specialized process. If transportation improvement plans are to be effectively implemented, it is increasingly important that they have widespread political and public acceptance. This can only happen if alternative evaluation is recognized as primarily a political rather than technical responsibility. And for the planner this means more rather than less involvement in the political decision-making process.

Since most critical problems in metropolitan travel exist during peak hour commuting traffic, the alternatives discussed in this paper will deal primarily with peak hour work trips between suburban residential concentrations and the central business district.

LOW COST TRANSPORTATION SYSTEM IMPROVEMENTS

Specific transportation improvements have merits of their own as well as those resulting from coordination with other improvements. It is the intent of this chapter to inventory reasonable low-cost alternatives and discuss them in terms of their individual advantages or disadvantages. Recognizing that realistically it is more important to identify improvement "types" as categories of implementable actions, the next step is to group the individual actions and relate them in terms of their general effect. Accordingly, this chapter discusses first the individual merits and demerits of specific actions and then groups them into categories in order to more realistically evaluate and correlate them with the goals and objectives of a particular region.

The following list includes most of the commonly recognized low-cost transportation system improvements:

1. Exclusive lanes for transit on existing arterials or freeways. (Which may eventually lead to staged development of specially constructed exclusive transitways if sufficient demand is generated.)
2. Work scheduling changes.
3. Engineering systems improvements (ramp metering, monitoring, and control systems).
4. Paved rail or canal rights of way.
5. Commuter car and bus pools.
6. Line haul feeder systems.
7. Demand-actuated transit service.

8. Automation of bus scheduling.

9. Prepaid transit (elimination of on-board fares).

10. Economic penalties and/or incentives (free or prohibitive parking).

11. Para-transit (jitneys, taxis, limos.).

12. Bus traffic signal preference systems.

13. Auto driver aids and directions (information signs).

14. Park and Ride facilities with express bus service.

These alternatives can be placed into categories according to the objectives which they satisfy, concentrating (in addition to their low-cost and implementation feasibility) on their effectiveness in (a) reducing energy consumption, (b) improving the flow of high occupancy vehicles, (c) increasing car and van occupancy, (d) increasing transit patronage, (e) encouraging walking and bike modes of travel, (f) improving measures to restrict traffic and (g) reducing the overall need for travel. Inherent in any of these alternatives is the assumption also of improved service and safety levels and reduced travel-time, congestion and pollution.

An important consideration is the relevancy of these alternative actions to medium-sized cities, i.e., cities with populations of 250,000 to 1,000,000. This can only be determined by comparing such factors as cost, lead-time, and political feasibility, to the basic objectives to be achieved. In addition, it is important to ascertain the effect a particular improvement will have on other improvements. Will improvements complement each other, conflict with each other, or be independent of each other? And will their impacts be beneficial or counterproductive? The planner should not fail to realize that low-cost alternatives may not be low-cost in the long run unless other objectives for improved transportation are achieved.

These and other problems will be addressed later in the thesis. First of all, each of the aforementioned low-cost alternatives will be described and discussed in some detail.

General Characteristics of the Alternatives

1. Exclusive lanes for transit on existing arterials or freeways.

The concept of exclusive lanes involves reserving a lane of an arterial street or a limited access freeway for the exclusive use of transit (normally buses). These lanes may be either direct flow (in the dominant flow of peak hour traffic) or contra-flow (against the flow of traffic in the non-peak direction). Contra-flow experiments have tended to be more successful, largely because they do not reduce the capacity of normal traffic flow in the dominant direction in order to achieve improved transit service. Actually, they may increase the normal capacity by removing transit from that dominant flow of traffic.

On arterials, bus lanes can increase speeds and reduce travel time more effectively with the aid of traffic control signs and signals. On freeways, either temporary or permanent barriers can be constructed to separate reserved lanes from other traffic during the peak hours. Safety has not been a problem in most experiments to date, although initially contra-flow lanes have lead to some confusion and the fear of a safety problem may have prevented some experiments from being initiated. Arterial facilities may not result in as great a reduction in travel time as those on freeways because of the interference of cross traffic, signals and other conflicting traffic controls. These problems may be reduced by means of signal pre-emption devices on buses and other similar measures.

However, in spite of the problems associated with arterials, the potential reduction in traveltimes and increase in transit capacity on these exclusive lanes is substantial. Therefore, the value of these lanes in specific bottleneck areas and highly congested corridors should not be quickly discounted.

Without a doubt, this type of low-cost alternative has been one of the most successful in experiments to date and its possibilities for modification to specific urban problems is immense. Examples of its success are the Long Island Expressway, Boston Southeast Freeway, and New Jersey I-495, which have achieved traveltimes savings in the range of 22% to 75%.

A more expensive alternative to reserving existing roadway lanes is the construction of special roadways for the exclusive use of transit. The capital costs of such facilities would be much the same as those of normal roadway construction. Therefore, high levels of transit demand are needed to justify such construction. Nevertheless, the speed, safety and high capacity of such facilities make them worthwhile considering in high demand corridors, if a high demand level can be shown and the additional costs justified.

The costs of designating existing lanes as exclusive transit or car-pool lanes are quite low. They include signs indicating "buses only" and special lane striping with virtually no operating costs on arterials. Traffic cones or posts may cost as little as $15 per placement.[1] Boston paid about $1200 per mile for signs. Its total cost for contraflow lane preparation was less than $50,000. Boston and Long Island pay about $500 per day for setting up and taking down cones. However, more permanent types of barriers could be devised which would eliminate this labor cost.

There is substantial variation in costs for specially constructed transitways. Estimates run from $820,000 per mile on the two-lane Shirley Highway exclusive busway to $1.048 million per mile on the San Bernardino busway.[2] The cost of buses has increased tremendously just in the past year or so, to about $65,000 for a 51-passenger bus. Buses alone can bring the cost of express systems associated with specially constructed busways into the millions of dollars. However, operating and maintenance costs of exclusive lanes should not exceed those of normally used lanes.

2. Work scheduling changes.

Shifts in work scheduling may result in greater efficiencies in the use of new and existing facilities. Changes would involve rescheduling work hours or days worked to such an extent that the demand for the use of transportation facilities is reduced in the peak hours

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1 U.S. Department of Transportation, Low Cost Urban Transportation Alternatives, Vol. I, "Results of A Survey and Analysis of Twenty-One Low Cost Techniques," January, 1973, (Prepared by R. H. Pratt, Kensington, Md.), p. 25.

2 Ibid., p. 33.

on the most congested facilities (e.g., a 4-day work week essentially reduces work trips by 20%). Such rescheduling may insure that a new facility doesn't exceed its capacity soon after completion. Even though this may be one of the least costly improvements, its success is dependent upon a high degree of cooperation and coordination among major employers. Without this cooperation, the impact of work re-scheduling will be negligible.

The only significant costs involved for work scheduling changes are those for data collection and surveys and initial planning. Downtown Lower Manhattan Association spent $50,000 for implementation of such a program.[3] Reduced transit patronage may result if work hours run late at night and/or a four-day work week is instituted. This could result in a loss of transit revenues, although the advantages of riding transit in the off-peak hours may offset this problem. Greater difficulties would result from trying to make carpool arrangements. The costs to employers are less tangible but also great. For example, a four day work week could result in difficulties in maintaining business contacts. Other economic problems could result. Work scheduling would probably be less costly if hours were variable, leaving considerable freedom in the hands of the employee to arrange his own work schedule and corresponding commuting schedule.

3. <u>Engineering systems improvements</u> (on-street parking controls, traffic direction controls, signalization, ramp metering, monitoring, and control systems).

Most of these improvements involve the expertise of traffic engi-

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[3] <u>Ibid</u>, p. 41.

neers and their well-documented manuals and experience. Like work scheduling changes, their success depends upon coordination with other improvements. Unlike work scheduling, they are not dependent upon voluntary cooperation. They can and must be reinforced by effective traffic regulations.

Experience clearly demonstrates that adjustments to traffic system controls such as light synchronization or demand actuated systems can significantly improve the flow of vehicular traffic in an area.

Channelization can improve the efficiency of traffic movement by providing either physical barriers to prohibit certain movements or by providing highly visible markings to guide traffic flow.

Less favorable public reaction can be expected for engineering improvements such as directional control (one-way street systems) and on-street parking bans or restrictions. To be successful, these improvements should be instituted only as part of an area-wide (e.g., CBD) system and with an enforcement program which is well-conceived and well carried out.

The above improvements have to do primarily with unlimited access streets and traffic control at intersections. Another engineering problem is the maintenance of stable traffic flow on freeways and other limited access facilities. These roadways are designed to carry certain calculated volumes of traffic at prescribed speeds. Metering, monitoring and control devices should concentrate on regulating access to the main flow of traffic. This can be done by calculating the number of vehicles entering the freeway at interchange ramps and limiting ramp access to the available capacity of the freeway. Such devices do not increase the actual capacity of the roadways. They merely prevent overloading and provide safer conditions for freeway traffic, thereby reducing congestion and insuring maximum capacity use. Flow monitoring, by which speed limits are changed by overhead signing, has not been very effective. Ramp metering, controling the rate of access before vehicles become part of the general flow of traffic, is a much more viable technique.

New traffic signals can be expensive, although they range from as little as $2000 per intersection to as much as $35,000 for complex demand actuated systems.[4] Signs are generally very inexpensive, ranging up to $40 each. Maintenance costs are not considerable. Metering and monitoring systems are much more expensive. Estimates for installing metering equipment per unit application average about $50,000. Additional subsystem elements may cost about $20,000. Operating and maintenance costs associated with computer leasing and personnel would be much greater, although they may involve the use of existing agency resources and personnel.

4. <u>Paved rail or canal rights of way</u>.

In many urban areas railroad tracks have been abandoned or are seldom used. In New Orleans for example, man-made drainage canals also provide rights of way which could be put to other uses. These rights of way may be paved over to provide an exclusive transitway at moderate cost. The basic requirement is that these rights of way be in re-

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[4] Ibid., pp. 59-61.

latively close proximity to major demand corridors so that access and egress are readily attainable. They would allow buses (or other transit) the same grade separation or grade crossing priority over automobiles which railroad cars receive. By utilizing existing rights of way, the problems of dislocation and right of way acquisition are avoided. Also a less expensive high capacity transit facility can be provided without reducing the normal flow capacity of existing freeway lanes. This is a very useful option for many urban areas to consider, provided the rail right of way corresponds closely to the major transportation corridors.

Implementation costs including removal of track, paving, drainage, signalization and landscaping would amount to about $200,000 per lane mile. The costs of closing and covering open canals may be more substantial. However, the added advantage of helping to reduce the health problems caused by open canals would make the additional cost worth considering. Operating costs would not be greater for the lanes themselves, but signal and control system costs may be considerable.

5. Commuter car and bus pools.

Car pooling, bus pooling and subscription bus service all involve an attempt to reduce the number of automobiles on the roads by increasing the number of occupants of each vehicle. This should result in an overall increase in the capacity of existing roadways by reducing vehicle miles of travel while maintaining person miles of travel.

To once again use a comparison to work rescheduling, commuter pools cannot be very successful if left to the voluntary initiative of a small proportion of the commuting work force. To be successful, commuter pools must be well organized.

The logic behind carpooling and buspooling efforts is the realization that although people live in decentralized locations and work in very centralized areas (thus the need for private transportation), there are usually a large number of people living in approximately the same area which also work in approximately the same area. Thus, even though these people may not know each other, they have much to gain by pooling their transportation resources and riding to work together. They can save money, save the hassles of having to drive everyday, and reduce the overall congestion on the highway, thus potentially also reducing traveltime to work.

The only basic difference between carpooling and buspooling is the size of the vehicle, hence the number of people who can participate in the pool. Also, the van or bus may be leased or purchased by the group or owned by the employer. (3-M experience in Minn.)

Subscription bus service involves a bus which is routed through a residential area to pick up passengers at their homes and then carry them to work on a line-haul basis. Each commuter reserves a space on the bus, and thus is ensured a ride to work each morning. One bus serves as collector, line-haul carrier, and distributor.

These systems are all feasible if well-organized and well-operated.

Costs of carpooling to the user are obvious. If there are two persons in the pool, each saves 50% of the cost of a trip; three persons would each save 67%; four would save 75%, etc. Implementation costs would be associated with only organized pools. It is likely that costs vary considerably between urban areas. Surveys and data processing may cost more than those for work rescheduling because they involve a greater number of variables and the need for periodic changes in the system.

The cost of vans for organized pools would average about $10,000 (for 12-passenger vans), although inflation keeps pushing this figure up.[5] Operating costs are in the order of 15¢ per mile for cars, somewhat more for vans, and at least $15.00 an hour for conventional bus operation.

6. Line haul feeder systems.

For persons living in low density residential neighborhoods with no direct transit access, the automobile has become essential because of the difficulty of getting from their homes to a line haul bus. However, many suburban commuters would ride transit to work if this difficulty were reduced or eliminated. One alternative would be for them to drive their cars to line haul bus stops or terminals, park their cars and ride transit. However, this requires available parking space at the transit station. The use of autos in this way causes unnecessary congestion in the vicinity of the line haul terminal, creates a demand for parking space, and reduces the availability of the auto for family use during the day.

In most line haul transit systems, either buses or commuter railroads, the capacity of these systems is underutilized, in large part because of the previously mentioned problems. In addition, many com-

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5 Michigan Dept. of State Highways and Transportation, Dial A Ride Transportation, Status Report, October, 1975, p. 9.

muters feel it makes little sense to drive a few blocks, park and ride transit when they could just drive the entire distance and park at their work places.

Feeder bus services brings the commuter from his home directly to the line haul station, without the need to fight traffic and find a parking space. Schedules can be coordinated so that the feeder bus arrival at the station coincides with that of the line haul carrier. The feeder bus could serve an additional purpose as local transportation service, thereby maximizing transit service in the suburban area and providing a dual source of revenues to support the system.

Implementation costs for feeder buses involve either the cost of new buses or the costs associated with rescheduling regular buses. While the cost of mini-buses (17-21 passengers) may cost ½ that of a 51-passenger bus, the cost of all transit vehicles has skyrocketed to an extent that new bus purchases are no small investment. However, UMTA will pay up to one third of such capital costs for transit facilities and vehicles. A modification of this type of system is demand-actuated transit.

7. <u>Demand-actuated transit service.</u>

Demand-actuated transit is a higher level of service of the "feeder" type which is generally very inexpensive for the user, but more costly to the operator and the public who must support it. It has most commonly been used as a feeder service to rail lines (as in Toronto) or as transportation for school children, the elderly, and the handicapped. Sometimes called "dial-a-ride" or "dial-a-bus", these systems allow individuals to call a dispatcher who responds by sending a mini-bus to an area to pick up one or more of these callers at their homes, usually within 10 or 15 minutes, and carry them to a line-haul bus or to a central community location such as a shopping center. The concept is that of providing taxi type door-to-door service at the cost of a bus fare. While a high level of service is provided, considerable public support is needed to finance such a system. The demand for new auto facilities is not necessarily reduced and in most cities the high operating cost would be prohibitive. Its most promising application would be as collector and distributor to high demand rail transit corridors and in small urban areas or suburbs which are willing to levy a millage to support it. Demand actuated systems also have potential as transportation for special groups such as the handicapped or elderly who find it difficult to use regular transit facilities.

Implementation costs amount to the purchase of vans or small buses, about $10,000 each, plus related computer and communications equipment which may run in the hundreds of thousands of dollars for a system of over 100 buses. Operating costs are more difficult to estimate, although the cost per passenger may vary from about $.85 to over $2.00.[6]

8. Automation of bus scheduling.

Most bus scheduling procedures used in cities today involve outmoded, ineffective manual techniques. Major schedule changes are very difficult to make, especially in the larger systems. It is not easy to change service patterns to reflect changes in demand over

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[6] Ibid., p. 17, Exhibit 5.

time. Automation (particularly computerization) of routing and scheduling procedures should lead to a more logical and efficient matching of service patterns and user demand. The major drawbacks to increased automation are the imperfection of computer programs and data processing procedures, and even more importantly, the reluctance of transit operators and unions to implement such costly and potentially labor saving devices. But while the initial cost may be high, the long-range improvements in transit system efficiency will benefit operators, managers and users alike. The potential for system efficiency is especially great where major changes or extensions of transit service are planned. Meanwhile, large and medium-sized cities should be accurately and consistently updating their surveys of users' origins and destinations so that when automated scheduling is available it can be put to its best use.

Matching vehicle scheduling with user demands will generally be easier than insuring reasonable scheduling of manpower to vehicles, maintaining regular 8-hour shifts and miximizing the productivity of operators without reducing overall union employment.

Implementation costs are dependent upon computer and related development costs which must be estimated separately for specific applications. Operating costs are also impossible to predict. For large systems, however, computer scheduling should not be greater than present manual calculation, but for small systems it could be more costly.

9. <u>Prepaid transit</u>.

The use of terminology in this category is important. Most discussions refer to "free" transit or heavily subsidized transit. The use of the term "prepaid" transit is a reflection of the author's philosophy that transit can obviously not be free and that subsidization is a highly inefficient means of supporting transit. The concept of fare collection, while equitable in the sense that everyone using transit pays a small amount to support it, is a very inefficient means and insufficient amount for such collection to be practical. For the small amount of money collected through the farebox, the time taken for the operator to collect fares and for the company to handle them is extremely wasteful.

The concept of prepaid transit suggests that fares be eliminated and that transit be paid for in the form of an additional tax on income earners. It has been estimated that for the average city, the average income earner would pay about $150 a year. The larger the family supported by each income earner, of course, the greater would be the overall savings. Inefficient fare collection and subsidizations would be eliminated, while the transit authority would be able to maintain modern equipment, pay better salaries and provide better service. Since the drivers would not need to collect fares, they could concentrate on driving. Loading time at each stop would be greatly reduced due to the elimination of both fare collection and the need for passengers to enter only at the front of the vehicle.

The greatest resistance to such a system would, of course, be suburban dwellers and the wealthy, who might be taxed the most in proportion to their use of transit. However, a form of negative incentive may be a good inducement to suburban commuters to ride transit. After all, if fares are eliminated, and fleets are well-maintained and more efficiently scheduled and operated, commuters will find that both time and money will be saved by riding well-financed and well-managed transit.[7]

10. Economic penalties and/or incentives.

The concept of variable fees for roadway use or parking is quite controversial. Proponents disagree both in philosophy and in their view of who should be penalized or rewarded. One philosophy contends that user service charges should reflect the actual cost associated with building and operating the facilities. Another is that user charges should reflect deliberate management objectives, designed for example to reduce traffic in the peak hours. Regardless of which philosophy is more valid, the goal is the same, to reduce congestion and to encourage use of more efficient modes of transportation such as mass transit.

A U.S. Dept. of Transportation report entitled Results of a Survey and Analysis of 21 Low Cost Techniques, has this to say of pricing techniques:[8]

> "The purpose for levying these fees, which would vary with the user's route and time of journey, may include
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> - Controlling the number of cars entering the central business areas.

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[7] Harvey Greenspan, "The Case for Prepaid Transit," Transit Journal, February, 1975, pp. 57-63.

[8] U.S. Dept. of Transportation, January, 1973, p. 159.

- Increasing trip speeds to a level acceptable to an optimal number of road users who will pay a premium for the privilege of using the road while other cars are excluded.
- Encouraging public transit ridership.
- Maximizing the usefulness of existing roadways.
- Shifting some demand to off peak hours.
- Encouraging car pooling.
- Encouraging relocation of residences and/or employment.

Reducing the number of automobile trips made during currently congested periods is a central theme of all of these objectives."

Without getting into the various methods of allocating costs, it is sufficient to say that such techniques are very complex, both in terms of implementation and effect. A great number of inequities could result. Economic penalties and/or incentives are subject to great variation depending on user patterns and the type of pricing scheme employed.

11. Para-transit (jitneys, taxis and limos)

Para-transit basically provides a higher level of service and greater flexibility at a comparably higher cost to the user. Greater reliance on para-transit, while meeting the specialized needs of a few, would do little to reduce the demand for new auto facilities. It may even be counterproductive if demand is reduced for other types of mass transit.

The greatest advantage of para-transit is its ability to serve any trip demand, to carry passengers from their actual point of origin to their actual destination with personal service and no transfers between modes. Such transit is important to fill the gap between the public transit system and totally private transportation.

The operation of such types of transit should be regulated for the safety of the public; however, there should be fewer restrictions on the number of these vehicles and their access to potential service areas.

Left to the private sector, implementation costs would be minimal. Cost to the operator would consist of the vehicles, insurance, and in some urban areas, a permit. The costs of larger operations include radios, dispatchers, and administrative work. Public regulation of such operations should be minimal and involve normal administrative costs.

12. <u>Bus traffic signal preference systems</u>.

Signal preference systems allow buses to signal traffic lights to stay or turn green as the bus approaches. Their use is only practical when there is ample roadway capacity ahead and when traffic on cross-streets is not considerably backed up. These systems work best in conjunction with exclusive bus lanes.

The two types of signal preference systems area: (1) the pre-empt system and (2) the priority system. Pre-empt systems hold the light green until the bus passes through, while the priority method holds the light for the bus for a certain length of time, but won't keep the light green if traffic is backed up. Therefore, the priority system is a more reasonable and workable application.

In Washington, D.C. costs for bus priority equipment ran about

$1787 per intersection, including detectors, transmitters, and other equipment.[9] Operating costs are those normally associated with maintenance of electronic equipment.

13. Auto driver aids and directions.

Experiments have been conducted (notably in Chicago and Detroit) in which signs along freeways change their message based on computer processed sensor data. As an example, such a system might show traffic conditions at interchanges by means of color codes. Green would represent no delay; yellow, moderate delay; and red, congestion. These signs have been used primarily in connection with ramp metering. The benefits to be derived from such signs appear marginal relative to the costs of implementation, and a uniform sign terminology or symbolism has not been developed. Nevertheless, any system which could be developed to alert motorists in advance of dynamic changes in traffic conditions, giving them the opportunity to reduce their traveltime by means of alternative routes, should be considered.

Costs for changeable electronic signs is very small, most costs including the computer system and devices associated with ramp metering. One estimate of this cost is $58,755, with the signs themselves costing only $90 to $237.[10] Operating costs are limited to maintenance, power, and circuit rental, about $2690 for a 10-sign sytem.

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9 Ibid., p. 245.

10 Ibid., p. 253.

14. <u>Park and Ride facilities with express bus service</u>.

Park and Ride is a system of auto-intercept (parking) locations tied together by a network of express buses. Each intercept point has a parking facility located on a major freeway or arterial corridor near a suburban residential concentration. The system allows commuters to park their cars near a major transportation corridor and ride an express bus to the Central Business District. Such a concept is consistent with stage-construction of freeways, <u>i.e.</u>, utilization of freeway medians for additional lanes as vehicle travel demand increases. These median lanes can logically be used for transit also. Initially, express buses can be used; as demand increases in the future, these lanes can be converted to light rail transit with faster, higher capacity vehicles.

Park and Ride is being discussed at the end of the list of concepts because it represents a regional transportation approach which combines the best elements of other concepts in an attempt to make transit competitive with the automobile. In order to reduce traveltime, preferential treatment on arterials is an essential element. Any means of giving preferential treatment to high-occupancy vehicles and penalizing low-occupancy vehicles will contribute to an overall reduction in traveltime and the inconveniences associated with congested roadways. Park and Ride represents a solution which is not irreversible in the long run. Express routes which generate insufficient demand can be eliminated. On the other hand, if demand increases sufficiently, buses can be replaced with a more efficient mode of transit, utilizing the same exclusive roadways. Buses can then be converted to feeder service.

The main costs associated with Park and Ride are land acquisition, construction of parking facilities, and the purchase and operation of buses. These costs will be itemized in greater detail in a later discusssion of New Orleans.

Such combinations of low-cost elements into workable systems represent the most sensible approach to solving transportation problems in medium-sized cities.

The following outline shows how the various low-cost improvements can be categorized by "type" of action:

1. Measures to improve flow of high-occupancy vehicles
    a. exclusive lanes
    b. preferential ramp metering and signal pre-emption for transit
    c. paved rail rights of way or covered canals.
2. Measures to increase car and van occupancy
    a. car and bus pools
    b. preferential ramp metering and exclusion lane usage for car and bus pools.
3. Measures to increase transit patronage
    a. line haul feeder systems
    b. demand-actuated transit
    c. automation of bus scheduling
    d. prepaid transit (elimination of on-board fares)
    e. prohibitively high parking taxes
    f. exclusive transit lanes and signal pre-emption devices

g. Park and Ride lots with express bus service.

4. Measures to encourage use of walk and bike modes.

5. Measures to restrict traffic

   a. engineering contraints

   b. control systems.

6. Transportation pricing measures

   a. economic penalties and/or incentives (free parking, parking and road user taxes, tolls, etc.)

7. Measures to reduce the need to travel (business or residential relocation).

8. Energy restriction measures

   a. increase transit patronage

   b. increase car and van occupancy

   c. improve flow of high occupancy vehicles.

COMPLEMENTARY SYSTEM IMPROVEMENT ALTERNATIVES

Clearly, it is not practical to consider implementing individual transportation improvements which would be counterproductive to other efforts to improve the system. This chapter, therefore, is concerned with the identification of types of transportation improvements which are complementary or which assist each other in maximizing the cost-effectiveness and goal attainment of the transportation system. This is accomplished by cross-classifying the categories of actions identified in the previous chapter and determining judgementally which are "assisting" improvements and should be given greatest emphasis in future analysis. This represents a modification of an approach used by Voorhees in a 1974 report for the U.S. Department of Transportation dealing primarily with energy consumption reduction measures.[11] After selecting the best potential complementary types of action, these actions are cross-classified with evaluation criteria for medium-sized urban areas, and prioritized according to the degree to which those criteria are met.

One action type which is counterproductive to the other types is "measures to improve total vehicle traffic flow." With more efficient employment of signal systems, traffic control devices, and ramp metering improvements, total vehicle flow may be less counterproductive to

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[11] Urban Mass Transportation Administration, U.S. Dept. of Transportation, Guidelines to Reduce Energy Consumption Through Transportation Actions, May, 1974, (Prepared by Alan M. Voorhees and Associates, Inc., McLean, Virginia), p. 29.

other action groups. Nevertheless, there is an inherent conflict in trying to reduce energy consumption by improving the efficiency of the general flow of traffic. The more efficient the flow, the more demand will be generated for that facility, and the greater the vehicle miles that will be travelled. More careful analysis should be conducted of ways to increase the efficiency of total vehicle traffic flow without hampering the objectives of energy consumption reduction and reduction of VMT.

The Voorhees report indicates that the following types of action tend to "assist" other actions or act independently:

1. measures to improve flow of high-occupancy vehicles.
2. measures to increase car and van occupancy.
3. measures to increase transit patronage.
4. measures to encourage use of walk and bike modes.
5. measures to improve the efficiency of taxi service and goods movement.
6. measures to restrict traffic.
7. transportation pricing measures.
8. measures to reduce the need to travel.
9. energy restriction measures.

Of these, "measures to improve efficiency of taxi service" and "measures to reduce the need to travel" both assist energy restriction, but otherwise act independently of the other elements. Excluding these two categories, then, Table 1 shows only those action categories which assist or complement each other. Each category is cross-classified with all other categories. When one action assists another type of

Table 1

Interrelationship of Complementary Transportation Improvement Actions

	Improve Flow High Occupancy Vehicles	Increase Car & Van Occupancy	Increase Transit Patronage	Encourage Walk and Bike Modes	Restrict Traffic	Transp. Pricing Measures	Energy Restriction Measures
Improve Flow High Occupancy Vehicles		X	X	X	X		
Increase Car & Van Occupancy	X					X	X
Increase Transit Patronage	X			X	X	X	X
Encourage Walk and Bike Modes	X		X		X		X
Restrict Traffic	X		X	X			X
Transp. Pricing Measures		X	X				
Energy Restriction Measures		X	X	X	X		

action, this is indicated by an X.

With the exception of "encouraging use of walk and bike modes," which is a small area consideration and "energy restriction" which applies broadly to most of the other categories, all of the actions in Table 1 deserve special consideration as elements which may have a substantial composite effect in improving metropolitan (regional) transportation.

More careful attention, therefore, will be given the following action categories:

1. measures to improve flow of high occupancy vehicles.
2. measures to increase car and van occupancy.
3. measures to increase transit patronage.
4. measures to restrict traffic.
5. transportation pricing measures.

Category 1 includes bus-actuated signals, bus priority regulations and exclusive transit lanes on arterials and freeways.

Category 2 consists of carpool or buspool programs and incentives.

Category 3 includes bus or commuter rail improvements such as scheduling or routing changes and expansions, fare reductions and free transfers, and reserved lanes and bus priority systems.

Category 4 involves primarily the suggestion of limiting traffic or prohibiting traffic from certain areas (such as the CBD) or from certain roadways at certain times of day.

Category 5 is suggestive of such measures as tolls at bridge or highway facilities based on the level of congestion, vehicle occupancy, time of day, or entry into an area (such as the CBD). The use of free parking at certain locations and prohibitively high parking rates at other locations is a means of managing the use of available urban space. This category may also include a graduated tax on total vehicle miles of travel or the weight and energy consumption levels of various auto types. This could be added to the annual auto licensing fee in most states. This annual fee could be increased significantly for larger "gas-guzzling" automobiles. Proof of participation in a carpooling program could also result in a rebate of a portion of the annual fee.

Correlation of Complementary Actions with Criteria for Medium-Sized Cities

Regardless of the objectives of a particular urban area for meeting its transportation needs, a number of criteria can be identified which serve to evaluate the overall acceptability of each category of transportation improvement action. These criteria can be weighted according to the importance placed on them.

Table 2 attempts to correlate those actions which complement or "assist" each other with some essential criteria for medium-sized cities. The method used is to simply assign a value of + 1 to all categories which adequately meet each evaluation category. Those criteria which are considered most important are assigned an additional point for a value of + 2. The criteria are taken from those generally considered important by transportation planners and engineers. The weights are applied to certain criteria on a judgemental basis and may vary with the situation. Nevertheless, implementation feasibility and political considerations generally supersede all others; therefore, it is important that the actions be capable of low-cost implementation, that they involve minimal organizational change or new legislation, and that the state of the art be such that there is no doubt that the action is technically feasible and workable. Table 2 is basically a check list of technical and political considerations. It can be constructed in more detail when this is considered desirable.

Action groups which meet the greatest number of criteria are: measures to improve flow of high occupancy vehicles, measures to increase car and van occupancy, and measures to increase transit patronage. Some categories may have short lead time for implementation and minimal institutional problems, but mixed public reaction and insignificant energy reduction. However, the cost and travel time savings to the individual user may make the particular action type potentially one of the most successful. Therefore, great care needs to be exercised in choosing the most relevant criteria for evaluation of each sub-item within these action groups.

As Table 2 indicates, measures to increase vehicle occupancy (including transit) and to improve the flow of those vehicles represent the highest system improvement possibilities on the basis of the criteria selected. Other criteria may be selected and perhaps a better method of rating and weighting the factors can be devised, but the outcome would be relatively similar. The three types of action which come out highest in this analysis offer positive incentives to both users and operators. They offer higher capacity system technology and a higher level of service to the user at relatively low implementation and operating cost. They are characterized by considerable adapta-

Table 2

Evaluation Criteria

	Energy Reduction (1)	Lead Time (Months)	Implementation Costs*	Org. Change or New Legis.*	Initial Public Reaction	Enforcement	Travel Time reduction*	Operating Cost Reduction	Safety	Lifestyle Change & Econ. Dislocation	Development Opportunities	Air & Noise Pollution	Congestion	Change in Land Use Patterns	State of the Art*	Total
1. Measures to improve flow of high-occupancy vehicles	0	+1	+2	+2	+1	+0	+2	+1	+1	+1	+0	+1	+1	+1	+2	16
2. Increase Car and Van Occupancy	+1	+1	+2	+2	+1	+1	+0	+1	+0	+1	+1	+1	+1	+1	+2	16
3. Increase Transit Patronage	+1	+1	+0	+2	+1	+1	+2	+1	+1	+1	+1	+1	+1	+1	+0	15
4. Restrict Traffic	0	+1	+0	+0	+0	+0	+0	+0	+1	+0	+1	+1	+1	+0	+0	5
5. Transportation Pricing Measures	+1	+1	+0	+0	+0	+0	+0	+0	+0	+1	+0	+1	+1	+1	+0	6

(1) Energy reduction in this case becomes a criteria for evaluation rather than an action category.

Only pluses and zeros are used because only improvements in the status quo or the lack of them is being considered.

*weighted (x2)

bility and flexibility in adjusting to variations in demand.

The action categories which come out lowest are disincentive or restrictive measures, restricting traffic from certain areas or roadways at particular times during the day, or pricing the use of certain facilities to discourage or control their use (a form of tax). Total prohibition of traffic is a difficult if not unreasonable solution to impose upon the urban traveler. Taxing the use of facilities seems a more reasonable solution, except that it is extremely difficult to develop an equitable and just means of restricting traffic in this manner.

All things considered, the positive physical solutions are potentially much more acceptable than the negative disincentive measures as means of improving system performance.

The preceeding correlation of action groups and evaluation criteria may not be sufficient as a basis for policy decisions to proceed to implement certain improvements. Most of the criteria used in the foregoing matrix analysis would correspond to the kinds of goals and objectives usually adopted for urban areas. Nevertheless, at this point in the alternatives analysis, it is essential to construct a check list in order to determine the extent to which the most feasible action types meet the broad goals and specific objectives which have been determined by policy-makers for the region. This is something which cannot be done without looking at a particular urban area. Therefore, this element of the analysis of alternatives will be discussed in the case study in a later chapter.

Meanwhile, the assumption can be made that the improvement actions are consistent and compatible with the region's goals and objectives, and that a package of combined actions can now be constructed for an implementable and workable regional system.

FROM CONCEPTS TO IMPLEMENTABLE SYSTEMS

PARK AND RIDE

The previous chapters have dealt with concepts, individual actions and categories of actions which are relatively inexpensive (compared to capital intensive construction and heavy rail types of systems), which complement each other and which adequately meet a broad range of criteria of effectiveness. Having passed these tests of correlation and evaluation, the preferred improvements remain fragmented groups of concepts and types. A package needs to be developed that brings together these concepts in the form of a workable system.

Of all the concepts previously discussed, one system that combines many of the preferred low cost alternatives is "Park and Ride". This chapter attempts to detail elements of the Park and Ride concept and its general utility as a framework for regional transit. The subsequent chapter makes specific applications of this concept to New Orleans which includes elements of the other concepts consistent with the correlative characteristics in Chapter 3.

Park and Ride

A regional Park and Ride system is composed of two basic elements:

1. parking facilities, and
2. express transit service to the CBD.

Parking facilities should be situated as closely as possible to major residential developments, and near major transportation corridors. By locating these facilities near centers of residential concentration, the distance which the commuter must drive is held to a minimum. Many people will be within walking distance of the facilities, and many that are not within walking distance will be close enough that another member of the family can drop them off at the Park and Ride point (the "Kiss and Ride" concept) returning to the same point in the evening to pick up the worker.

If the commuter must drive as far as the Park and Ride interchange point, he will have a space to park at much less cost than he would pay in the CBD. If he can walk or arrange to be dropped off, his only cost for the trip is the express transit fare. Thus, the second basic element of the Park and Ride system, the express bus, must be able to accommodate more commuters than just those auto drivers and riders who are expected to use the parking facility.

Park and Ride systems have been given close attention recently due to the energy crisis, the rising cost of gasoline and concern on the part of both individuals and society of finding ways to decrease consumption of gasoline by the automobiles.

Park and Ride can also decrease the necessity for many families to own more than one automobile. As well as being able to park the family car in a suburban lot, it is also possible for a member of the family to drop off the commuting member(s) of the family at the express bus stop and keep the car for family use during the day. Thus, cost is an important consideration both in terms of the user's capital and operating savings and society's efforts at energy conservation.

While the Park and Ride facilities are intended to serve primarily peak hour commuters as an alternative to driving a car to the CBD, they may be further utilized on weekends as a bus service for special cultural or recreational events. The peripheral lots would remain open at all hours to provide parking for events in their vicinity. The outlying lots could also serve as staging areas for groups carpooling for special events. By encouraging use 7 days/week, vandalism and loitering would be minimized.

Exclusive Busways

While reduction in costs will attract a marginal number of people to the Park and Ride system, in the long run, for a large proportion of commuters to be drawn to the system, it must also represent an appreciable time savings.

As previously mentioned in Chapter 2, the use of exclusive bus lanes is a particularly promising approach to obtaining considerable time savings for transit. Figure 1 illustrates time savings in major experiments to date. In spite of the low cost benefits of exclusive bus lanes, its application and use is limited to moderately heavy demand corridors. A 1967 Statement of Position by the FHWA suggests a range of 120 to 180 buses per hour (6,400 to 9,400 bus seats per hour) as minimum justification for the designation of a freeway lane as an exclusive busway. Preferential access to the freeway lanes for buses is recommended by limiting inflow of other vehicles on the freeway ramps in cases where volumes do not justify exclusive lanes.

Nevertheless, success with the express buses operating in mixed traffic flow, by convincing people of the savings in cost and the convenience of leaving the driving to someone else, may result in sufficient increases in demand to justify designation of reserved lanes in the future, resulting in considerable time as well as cost reductions.

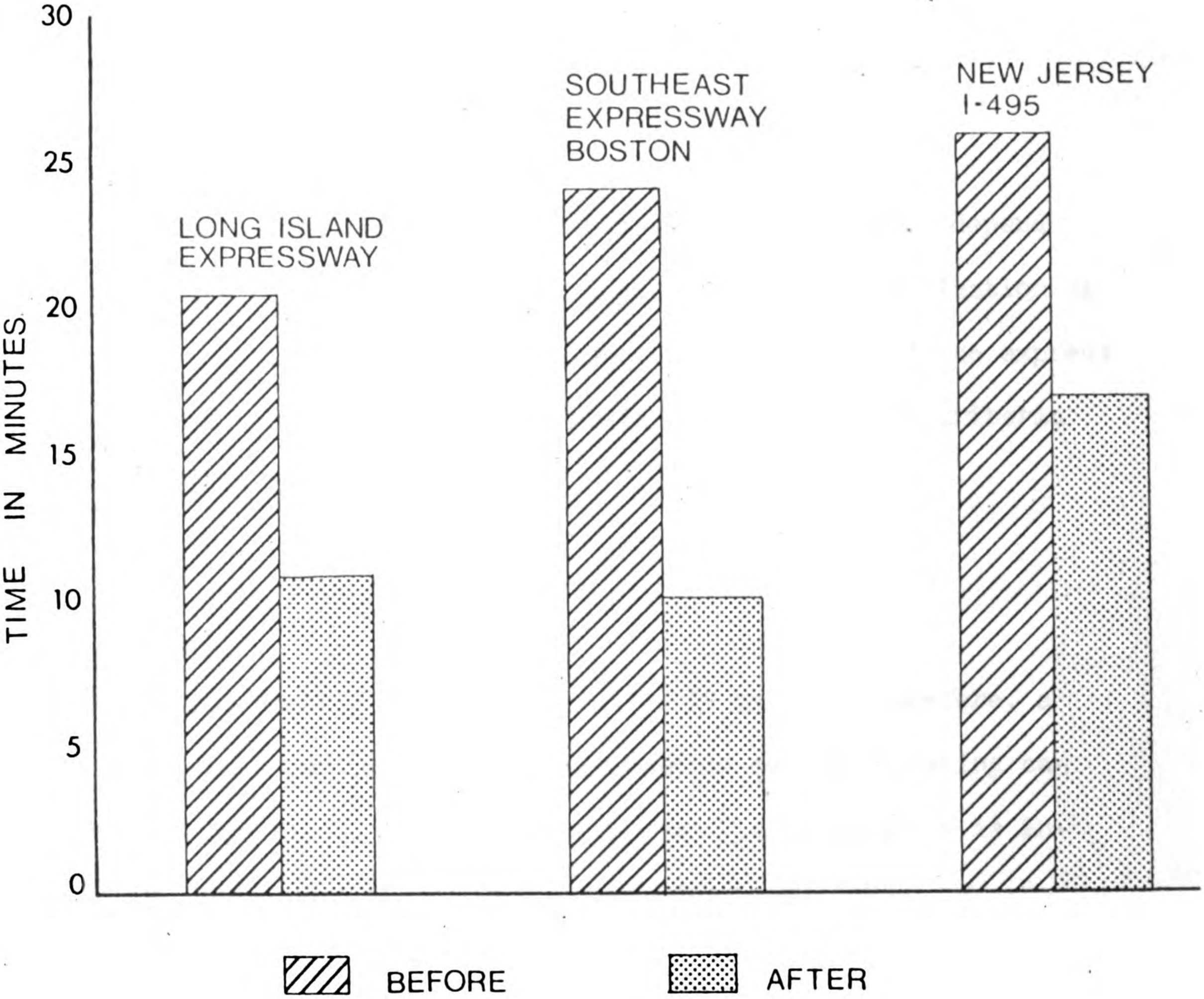

FIGURE 1 TRAVEL TIMES BEFORE AND AFTER IMPLEMENTATION OF EXCLUSIVE BUS LANES

Source: U.S. Department of Transportation, Low Cost Urban Transportation Alternatives, Vol. 1, January, 1973.

The exclusive busway is an approach which seems to follow logically from successful express bus operations to a more efficient, higher capacity system of transit. It is an improvement which can be staged easily, which maintains flexibility for future modifications, and which has been demonstrated capable of meeting projected demands.

Capacity Criteria

While the capacities for parking at each location will depend largely on physical design criteria, i.e., the maximum utilization of available space at a desirable location, the capacities of the express bus system can be calculated on the basis of two important criteria:

1. vehicle capacity, and
2. roadway capacity

Vehicle Capacity

Most buses contain a maximum of 45 to 53 seats. Therefore, a value of 50 seats per bus is generally used to estimate seating capacity for a bus fleet. In regular bus operations, capacity is increased by 30% or more to account for standing passengers. However, for express bus transit, it is considered desirable to operate with all passengers seated, since higher speeds and greater distances are involved.

Roadway Capacity

The second step in determining capacities of transit systems is to calculate the number of vehicles that can move over a given section of roadway during a given period of time. This is contingent upon several considerations:

> "1. The type and use of roadway—whether in mixed traffic on an ordinary street or on a freeway or expressway; whether in an exclusive lane from which all other vehicles are barred or in a private right-of-way;
>
> 2. The time and frequency (spacing) of service stops—each service stop involved the time elements for deceleration, for passengers to board and alight, and for acceleration to normal running speed;
>
> 3. The rate of speed at which the vehicle travels. The safe clearance space (minimum safe headway time) between vehicles is progressively larger as running speed increases, and
>
> 4. Whether the vehicles are operated singly or coupled into trains. The coupling of two or more vehicles into a train makes them in effect a single vehicle for the purpose of minimum clearance (headway) requirements."[12]

The total system capacity of the individual vehicles multiplied by the roadway capacity (persons/vehicle x vehicles/hour = persons/hour).

Specific Park and Ride route proposals will emphasize:

1. use of roadway with highest level of service, or least congestion and intermodal conflict
2. minimizing service stops
3. maximizing the rate of speed
4. achieving headways which involve minimum waiting time while still achieving a near capacity level of ridership on each bus during peak hours

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[12] Automobile Manufacturers Association, The Potential for Bus Rapid Transit, February, 1970, (Prepared by Wilbur Smith and Associates, Columbia, S.C.), pp. 41-42.

5. minimizing the necessity for transfers within the CBD by routing express buses along major CBD streets.

In most cases, of course, freeways or expressways would represent the highest level of service, except in bottleneck areas or sections near the CBD which are particularly congested. However, regional arterials may be preferred in locations where they provide better access to residential concentrations. Also, as the express routes approach the CBD, better service may be provided by routing the buses off of major corridors onto less congested roadways with a lower capacity but a higher peak hour level of service. These judgements should be made with respect to type and use of roadways which would provide the highest capacity of express transit in mixed traffic flow.

Ultimately, the decision to develop busways or rail transit will depend on cost comparisons and service factors, i.e., how the greatest number of people can be served at the lowest cost. Capital costs will depend on both the type of facility and the extent of its application. Buses can provide greater coverage than systems built on lengthy guideways constructed on separate rights-of-way because they can use freeways and arterials for much of their line-haul operations. On the other hand, rail rapid transit not only requires more extensive separated guideway construction, but the services provided on the rail right-of-way must be supplemented by buses at transfer and terminal points.

Busways have the further advantage that in the few metropolitan areas where a high level of peak ridership (8,000 to 12,000) is projected, high-quality express bus service can provide a temporary service until conversion to a rail or fixed guideway system becomes essential and practical.

Several considerations must be realized with respect to the practical application of bus rapid transit to freeways. First of all, the faster speeds which are attainable on freeways can adequately reduce travel time only if the trip is long enough to overcome delays due to service stops. Secondly, buses cannot achieve an optimum level of performance if they must compete with auto traffic for space at the terminal end of the trip, that is, after leaving the relatively free-flowing condition of the freeway or exclusive bus lane. It may be more logical to plan for exclusive bus lanes on congested arterials before increasing the capacity of bus transit on the less congested (freeway) portions of the trip.

Patronage Estimates (Determining Demand for Park and Ride)

Patronage estimates (determination of the origin trip ends) are based most importantly on the market area. Such factors as population density, residential density, distance to the CBD, transit usage, and auto ownership are "market area" characteristics which are most important.

Certain guidelines should be adopted for determining both remote and peripheral park and ride facilities. They can be put into three categories: market area characteristics, activity center characteristics, and Park and Ride service characteristics.[13]

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[13] George Tanner and Rose Barba, N.Y. State Dept. of Transportation, Park and Ride Transit Service: Some Guidelines and Considerations for Service Implementation, PRR#44, April, 1973, p. 17

Under market area characteristics, it is important to consider the accessibility of the area to a major corridor tying the Park and Ride site with the CBD (or other activity center). In fact, it is best that only one major roadway serve the area, preventing alternative mode and route possibilities which would reduce demand for the Park and Ride facility. The dimensions of an area may vary considerably, corresponding generally to census tract or traffic zone boundaries. Remote lots should be more than 3 miles from the CBD. Table 3 shows that of several studies reviewed, the distance varied from 4 to 14 miles. Most studies also show a time savings of 15 to 30 minutes of run time.

Within the market area itself, there should be a relatively high proportion of residential land to transportation land. There should not be a large proportion of mixed land use in the area which would reduce the necessity of leaving the area to work.

The Rochester, N. Y. experience suggests 1200 persons per square mile as a minimum population density which could support an efficient Park and Ride operation.[14] More ridership can also be expected from areas with a large proportion of one-car households. Suburban households with only one car are most likely to have competition within the family for the use of that vehicle, creating a need for alternative transportation. Since Park and Ride is designed principally to relieve peak hour congestion for work trip commuters, most of the employees served by a market area would work "normal" daily eight hour shifts.

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14 Ibid., p. 23

Table 3

Park-and-Ride Characteristics from Selected Studies

Mode	REMOTE					PERIPHERAL
Source	Tri State	Milwaukee	Seattle	MATS	CUTS	Atlanta
Reference	(11) (24)	(8) (2)	(3)	(10)	(6)	(8) (1)
User Characteristics						
Percent of Corridor Travelers Diverted to Park-and-Ride	N.A.	6%	N.A.	4-27%	N.A.	1.1%
Trip Distance to site 60% users within	2¼ miles	2-2 ½ miles	3½ miles	N.A.	N.A.	10 miles
Trip Distance to site 90% users within	4+ miles	3-5 miles	6½ miles	N.A.	N.A.	10+ miles
Travel Alternatives	N.A.	70% auto	69% auto	56% auto	N.A.	80% auto
Mode of Arrival: auto driver	N.A.	35-59%	76%	32%	N.A.	80%
auto passenger	N.A.	29-37%	5%	9.5%	N.A.	17%
walk	N.A.	1-16%	4%	13%	N.A.	—
transit	N.A.	5-28%	—	—		—
Percent Kiss-and-Ride	N.A.	15%	14%	36%	N.A.	N.A.
Trip Distance to site-Kiss-and-Ride 60% within	N.A.	N.A.	2 miles	N.A.	N.A.	N.A.
Auto Occupancy of site users	N.A.	1.2	1.06	N.A.	N.A.	1.26
Location Characteristics						
Distance to Destination (CBD)	8 miles	7-14 miles		4-8 miles	1-3 miles	3/4-1 mile
Proximity to Major Transportation Services	N.A.	¼-½ mile	exclusive ramp	on arterial	arterial	arterial
Joint Use of Parking Area	Yes		No	Yes	No	No
Number of Available Spaces (paved)	50-700 spaces/site	50-300 spaces/site	475 spaces	50-70 spaces/site	300-950 spaces/site	300-950 spaces/site
Percent of Spaces Used	N.A.	50%	100%	50-100%	40-80%	50-80%
Presence of Bus Shelter	N.A.	Yes	Yes	No	Yes	Yes
Illumination	N.A.	Yes	Yes	Yes	Yes	Yes
Telephone and Newstand	N.A.	Yes	Yes	Not as separate facility	No	Yes
Security	N.A.	None	None	None	N.A.	attendant
Access	N.A.	N.A.	Signalized	some signalized	some signalized	N.A.
Time Saved (over conventional transit)	N.A.	30 minutes	15 minutes	15-30 min.	N.A.	10-15 min.

Source: Preliminary Research Report No. 44, New York State Dept. of Transp., April, 1973

At the activity center end of the trip, which is usually the CBD, some 15% of work trips may be destined. In most urban situations, this would be the highest percentage of work trips attracted to any one centralized area. In any case, Park and Ride should serve only major employment centers (at least 10,000 employees), and to maximize Park and Ride service efficiency, most work trips should be arriving and departing the CBD during peak hours.

Patronage can be based either on a method comparing traveltime and cost by auto and transit, or a less precise, but generally acceptable alternative. This second alternative method would be to calculate the number of workers traveling from the market area to the CBD which can be determined from U.S. census data. From experience in other studies (Table 3) a range of 4% to 22% of commuters have been diverted to remote Park and Ride along major corridors. These percentages can be applied to the total commuting work force to provide a rough estimate of park and ride patronage. Comparing the potential corridors and locations, priority rankings can be determined. The second method of estimating patronage does not consider costs or comfort levels, etc., which should provide the greatest inducements to prospective park and ride users. Nevertheless, either method provides a means of identifying the most favorable areas for park and ride service.

Park and Ride should not attempt to compete with "successful" transit operations serving an area unless increased demand can clearly be established. While traveltime must be reduced in the long run to attract riders, initially patrons are less sensitive to relatively minor travel time differences between auto and Park and Ride than they are to cost savings. Generally, if parking is ideally located and free and transit fare is kept quite low, commuters perceive this as the greatest benefit involved.[15] Service should be dependable, should be non-stop from origin to destination, and should be capable of rerouting itself to avoid congested areas (perhaps with the assistance of radio warnings of congested roadway conditions). Headways should be kept low (preferably 10 to 15 minutes). Nevertheless, there are considerations which must be balanced to achieve the best service at a reasonable cost.

The matrix on the following page (Table 4) shows some of the negative and positive effects of park and ride systems on various concerned groups.

Selecting Park and Ride Lot Sites

The problems of finding adequate urban space for large peripheral lots is considerable. Lots of smaller size needed for remote operations should be less difficult to find, but their location is very important in insuring the success of the operation. The major concerns are (1) accessibility from residential concentrations to the major corridor, (2) the parking capacity of the lot itself, and (3) placement of the lot well away from hazardous or unattractive adjacent land uses.

Accessibility should be provided not only for parkers, but for bicycles and pedestrians, and for "kiss and ride" drop off areas.

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[15] Carol Keck and Peter Liou, N.Y. State Dept. of Transportation, Forecasting Demand for Peripheral Park and Ride Transit Service, PRR#56, March, 1974, p. 25.

Table 4

A Matrix of Park-and-Ride Effects

Effect	System User	System Operator	City (CBD)	Site Owner	Employment Center	Physical Environment	Community (Market Area)
Negative	1. fares 2. loss of freedom of movement 3. must park some distance from destination and transfer to bus 4. loss of privacy	1. operating costs 2. capital costs 3. promotion costs	1. promotion costs	1. snow removal 2. conflict with other users 3. promotion costs	1. snow removal 2. promotion costs 3. conflicts with non bus riders	1. pollution due to bus 2. increase in auto pollution from freed auto	1. extra traffic or localized congestion due to Park and Ride facility
Positive	1. service-speed, comfort, convenience 2. parking benefits 3. freed auto (possibly) 4. psychological freedom from driving worries 5. arrive much closer to destination 6. opportunity for socializing	1. fare (revenue) (plus revenues from promotion effort)	1. benefits of reduction in parking problems (savings 2. promotion of trade 3. increase in tax revenues from greater business 4. opportunity to reuse land that would otherwise be tied up in parking	1. increase in business or increase in site's other benefits 2. promotion of trade	1. reduced parking requirements 2. fewer cars to contend with 3. opportunities to better use former parking space	1. net pollution reduction due to bus in place of auto's work trip	1. enhanced mobility within the market area from the freed auto

Source: Preliminary Research Report No. 44, New York State Dept. of Transportation, April, 1973

Capacity should include adequate and safe maneuvering space and bus loading areas. The lot should be placed in an attractive setting to encourage its use.

The smaller remote lots should use existing facilities wherever possible, so that if the service is a failure, it can revert to its former or primary use without considerable cost. When a new lot must be constructed, it is preferable to use vacant land or already paved land.

In suburban areas there is the potential for parking facilities which already exist to serve other commercial or institutional uses but which are sizeable enough to also be used for Park and Ride purposes. The only major problem with using such facilities is the conflict which may develop between Park and Ride users and original purpose users.

Shopping centers (or malls) often have excess parking, particularly on weekdays. A small number (50 or 100 spaces) could probably be spared for Park and Ride in the large or overbuilt centers. Also, Park and Ride patrons would tend to shop at the center stores at the end of the day, although it may be difficult to convince the center management of that fact.

Theatres are usually located just off of major roadways, and those not offering daytime shows have large, scarcely used lots available during the day. The only requirement for Park and Ride use would be an assurance to theatre management that all park and ride patrons be out of the lot well before evening crowds begin arriving.

Church properties which are large and underused during the day may be good candidates for park and ride. Also, municipally-owned real estate located on major thoroughfares would be very inexpensive for parking facility use. However, such use must insure against conflict with other users of the available parking space.

Park and ride facilities should be situated where there is a high level of ridership potential, where there is sufficient land or underutilized commercial space to accommodate the anticipated level of usage, and where auto access is easily accomplished. In addition to existing private and public spaces already mentioned, rail right-of-ways, medians, and interchange overpasses provide underutilized and available space which may be considered appropriate.

Peripheral Park and Ride

Park and Ride is commonly associated with suburban parking facilities and express buses tied to the CBD. This is sometimes called "remote" park and ride. However, another type of system is "peripheral" park and ride. With this type of system there are a smaller number of parking facilities located near the major corridor entrances to the CBD, each of which is quite large. Commuters drive from the suburbs to the periphery of the CBD, park their cars and then ride transit (or walk) to some point in the CBD. The advantage of this type of park and ride is the ability to drive at one's own schedule and one's preferred route and in the comfort of one's personal vehicle on the uncongested portion of the commute trip. Then the commuter can park in an uncongested peripheral CBD location, pay a relatively low parking fee (compared to interior CBD parking) and ride transit at the congested end of the trip, with lower headways and better collection and distribution than the remote express buses can provide.

Both systems have their proponents and opponents. From the user point of view, it's a matter of personal choice, depending on the level of service and convenience provided or which provides the fastest, least costly trip with the fewest transfers between point of origin and point of destination. For the operators and political jurisdictions, it is a question of who benefits the most and who has to pay. The burden of a remote park and ride system would most likely be born by the suburban township or parish (county) governments, whereas a peripheral park and ride system would put much, if not all, of the burden on the central city, although the benefits to the CBD would also be substantial.

Tentative peripheral parking locations should be identified at points of major access to the CBD. These locations require large capacity (up to 2000 spaces) in comparison to remote lots. Large tracts of vacant land on the periphery of the CBD may be difficult to find. As a result, available space along major access corridors should be found before any other considerations of demand or service are made. The peripheral parking facility has a much larger market area than a remote lot would have. Basically, it serves all commuter traffic funneled into the CBD along a major access corridor. The typical CBD might have four such corridors, one from each primary direction. The market area would resemble a slice of pie, with the peripheral park and ride facility intercepting traffic at the apex, near the edge of the CBD.

The length of this funnel would be a maximum of 10 miles and the width would be determined realistically in a manner similar to remote service areas, by population and residential densities along major routes.

Data from Table 3 indicates a range of 3/4 to 4 miles as the distance from the CBD at which peripheral lots have been located. An intermediate distance would be most realistic (i.e., 3/4 mile is too close, 4 miles too distant).

Travel time savings are not substantial with peripheral parking. Unless preferential treatment is provided along the congested portions of the transit loops (a significant portion of the transit route within the CBD), travel time will be comparable to any vehicle in mixed traffic. The time which is saved is that which the commuter would devote to finding a parking space. The same minimum population density of 1200 persons/square mile should apply to the outer edge of the market area as in the case of remote service. Unlike remote market areas, experience shows that a high percentage of peripheral parkers are from families with 2 or more cars. Greater work hour variation can be tolerated by the peripheral park and ride system because it is feasible to provide bus service between peripheral lots and the CBD with very low headways over the course of an entire day. The requirements that the CBD (or other activity center) be a major employment center holds for peripheral as well as remote park and ride.

Locating peripheral lots at points on major corridors in such manner as to intercept auto traffic before it reaches the congested segments of the trip, will result in much higher patronage. Of course, operators must also insure that peripheral parking costs are sufficiently low that CBD interior parking is very unattractive in comparison. Transit operations must provide a very high level of service, emphasizing frequency and short distance to the CBD destination.

A primary objective is to reduce the concentration of autos in the CBD and the amount of area devoted to parking in the core area.

The choice of parking for the individual commuters must be recognized as a tradeoff between parking cost and the time spent in parking and then walking to one's final destination. One way of measuring this trade-off is to identify a relationship between cost and walk time or distance and then estimate changes in demand under different conditions of parking supply and cost.

This method should be particularly helpful in determining the cost which commuters would be willing to pay for peripheral parking at those facilities which are located at greater distances from the commuter's destination.

A more precise means of determining the advantages of particular mode-change operations, such as park and ride, would be to calculate time and cost for two or more modes, translate time into a measure of cost, and establish the magnitude of time/cost difference between modes. A well-planned peripheral park and ride operation ought to show a reduction in time/cost over the auto-only mode. Table 5 shows some of the major elements of time and cost for two modes.

It is evident from these comparisons that travel time differences with the transfer and/or parking and walking times involved, probably will not be significant unless an extremely efficient operation is

Table 5

Travel Time and Costs Elements

	TIME	COST
PARK AND RIDE	1. Walking to car. 2. Driving to parking lot. 3. Parking and waiting for transit. 4. Transit to final dest.	1. Auto operating (running cost to parking lot). 2. Parking and/or transfers.
AUTO	1. Walking to car. 2. Driving to activity centers. 3. Parking. 4. Walking to dest.	1. Auto operating cost. 2. Parking fee.

developed. This makes it imperative that Park and Ride cost savings be substantial in order to induce commuters to park at a peripheral location rather than the core area. As a result, parking should probably be treated as a public service rather than a source of revenue, with transit fares remaining the same or lowered. Besides the initial construction cost, operation and maintenance of parking facilities would not be great. But regardless of the cost, central city governments must pay the price for reducing the congestion and improving the viability of the major activity center.

NEW ORLEANS CASE STUDY

In Chapter 3, complementary improvement categories were identified and cross-classified with a broad range of evaluation criteria. It was decided that the additional step of identifying goals and objectives was necessary if a specific urban area was being studied. Therefore, before getting into a discussion of the application of Park and Ride to New Orleans, it is important to consider the extent to which the major elements of such a system are compatible with the goals and objectives of the New Orleans region. The following goals and objectives were adopted by a Technical Advisory Committee (12-75) and Intermodal Management Team (1-76) for the New Orleans Metro Transportation Study.

Transportation Goals:

> To develop and adopt regional transportation plans and supportive policies which provide for a safe, efficient, economical, and attainable transportation system which serves all area residents (including elderly, handicapped, low income, etc.) in an equitable manner; supports regional land use goals and policies; and enhances environmental, sociological and aesthetic values.

Objectives:

I. Develop a regional transportation plan that would

  a) provide and encourage alternatives to the auto;

  b) provide a high level of transit service in areas and corridors where congestion and population densities are greatest;

  c) provide for a safe system of travel;

  d) minimize travel times;

  e) minimize energy consumption;

f) minimize air and noise pollution;

g) provide cost/effective services;

h) minimize dislocation, and/or disruption;

i) promote and/or preserve existing community values

j) promote joint use and development possibilities, and

k) minimize congestion.

II. Ensure the implementability of the transportation system by developing plans and/or programs which

a) have broad community acceptance;

b) are adaptable to phased construction;

c) are adaptable to variations in forecast growth; and

d) are within the ability to fund.

III. Maintain a continuing transportation planning process which is truly comprehensive and cooperative.

A cross-classification of transportation objectives with elements of the proposed New Orleans Park and Ride system shows the extent to which objectives are attained by each element of the system. (Table 6)

The objectives are consistently met by the elements of a park and ride system, particularly the basic elements: express buses and remote or peripheral parking facilities. In reality, the planner would defend these judgements and policy-makers would decide their degree of adequacy. However, for the purposes of this case study, the assumption will be made that the planner's judgement is adequate and that the goals and objectives of the transportation policy makers are in fact met by the basic elements of a regional park and ride framework.

Table 6

Attainment of Objectives

Action Packages

Transp. Objectives (sub-elements) for the N. O. region	Express buses	Remote & peripheral parking	Exclusive transit & car/van pool lanes	Bus & actuated signals	Bus & car-pool prio-rity re-gulations	Ramp metering
Alternatives to auto	X	X	X	X	X	
Transit in congested areas	X	X	X	X	X	
Safe travel	X		X	X	X	X
Minimize traveltime	X		X	X	X	X
Minimize energy consumption	X	X			X	X
Minimize air and noise pollution	X	X	X	X	X	X
Cost/effectiveness	X	X		X	X	X
Minimize dislocation	X	X		X	X	X
Preserve community values	X	X	X		X	X
Promote joint use development	X	X	X			
Minimize congestion	X	X	X	X	X	X
Broad public acceptance	X	X	?	?	?	X
Adaptable to phased construction	X	X	X	X	X	X
Adaptable to variations in growth	X	X	X	X	X	X
Within ability to fund	X	X	X	X	X	X

Regional System

Six major transportation corridors have been identified for the New Orleans region which provide access from outlying areas to the CBD. Potential areas for Park and Ride facilities have been identified which provide access to these corridors and also serve major concentrations of residential development. Figures 2 and 3 show the location of these corridors and potential sites.

Some of these locations (Figure 3) are unworkable or unsuitable for the following reasons:

1. Use of private facilities involve legal questions and difficulties related to public control and coordination with the major intended uses of the private facilities, e.g., parking space requirements per commercial establishment, and conflicts with normal theatre operations.
2. Incompatibility with expected area development.
3. Existence of a more desirable location in close proximity to other potential sites, i.e., closer to major residential developments and having better access to a major transportation corridor.

On the basis of these limitations, many locations can be rejected by decision-makers as sites. Figures 4 and 5 illustrate two of the ways in which existing right of way can be put to good use as a park and ride facility directly accessible to exclusive transit lanes.

General Description of Sites

Most of the sites recommended for the New Orleans region are of

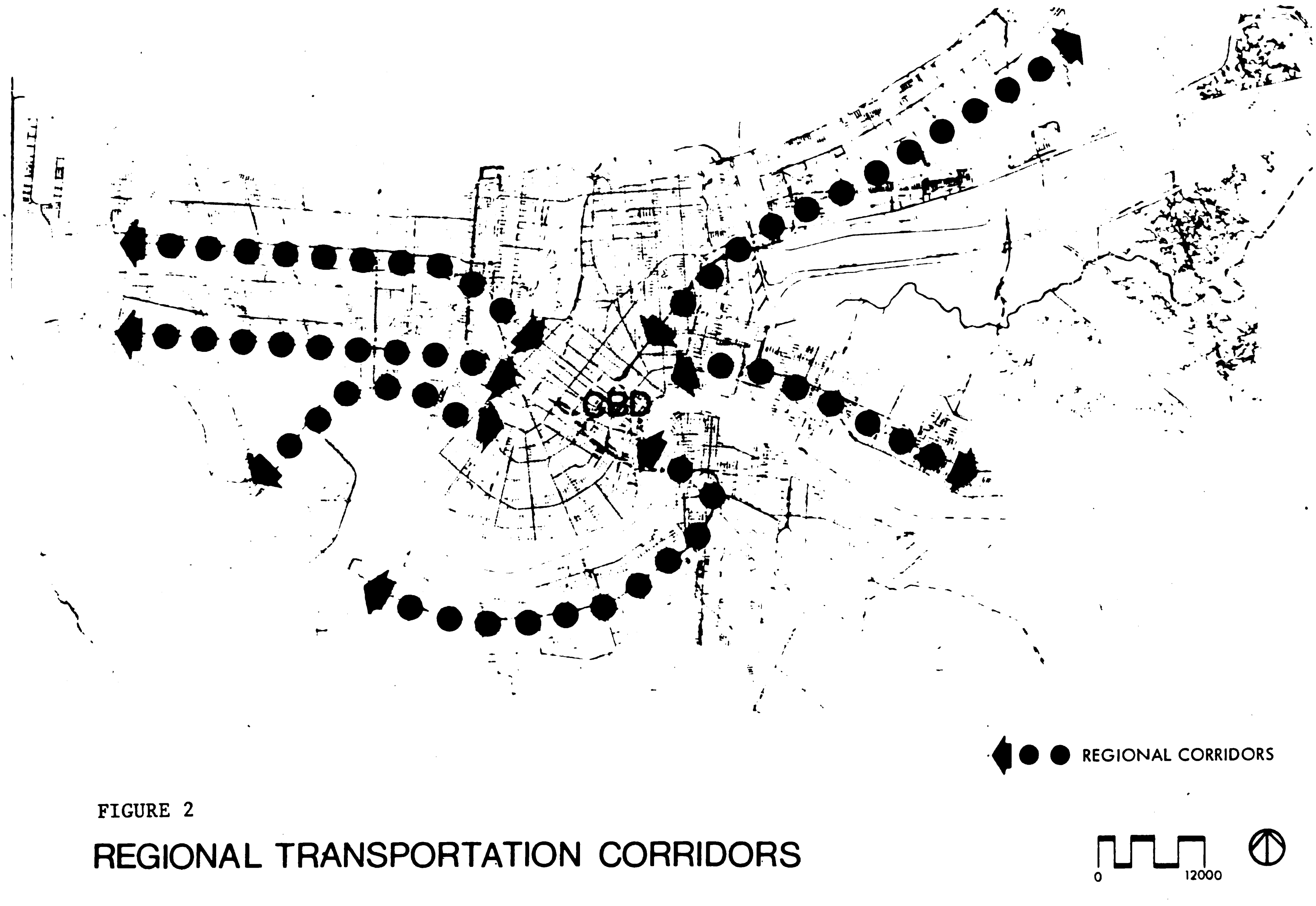

FIGURE 2

REGIONAL TRANSPORTATION CORRIDORS

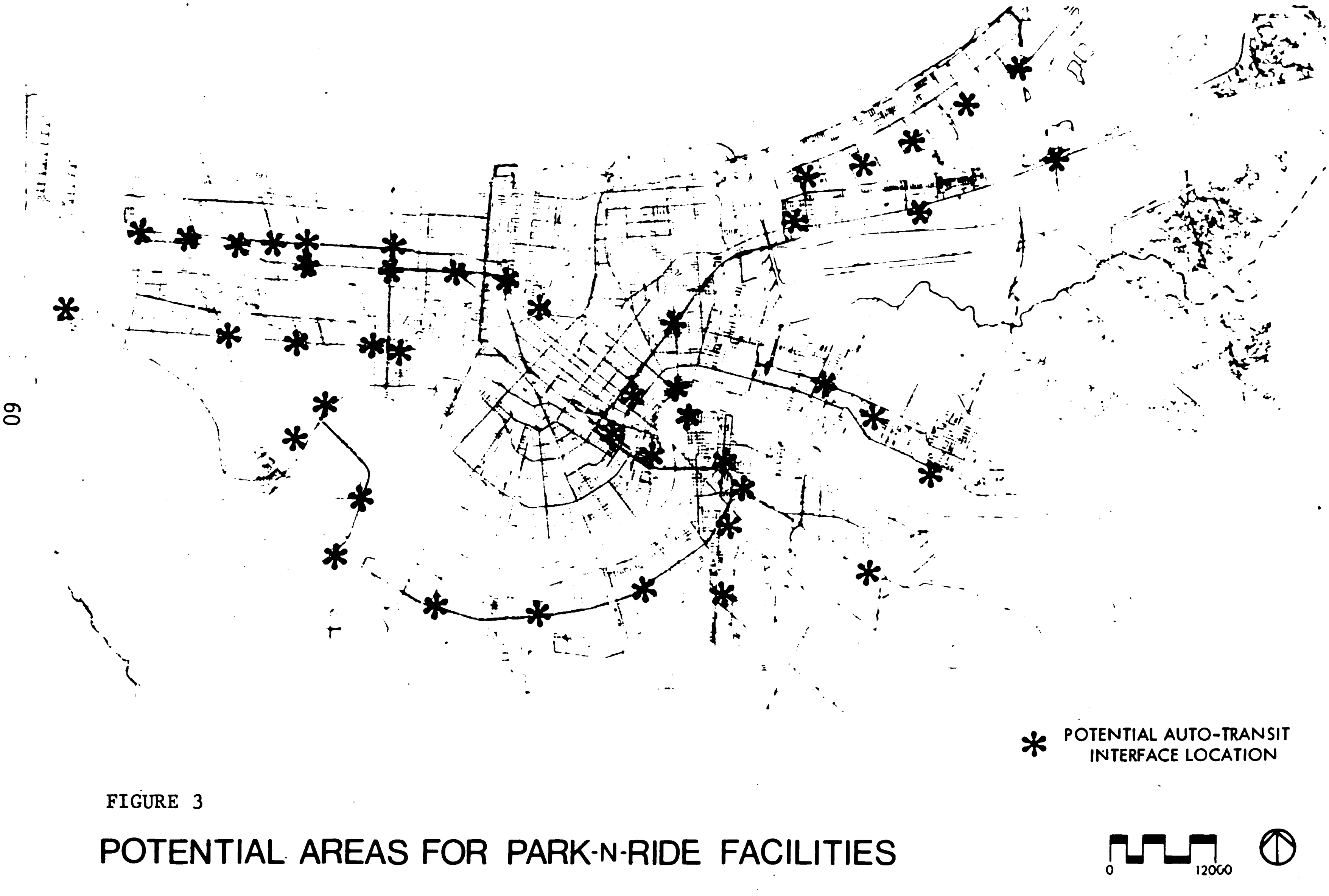

FIGURE 3

POTENTIAL AREAS FOR PARK-N-RIDE FACILITIES

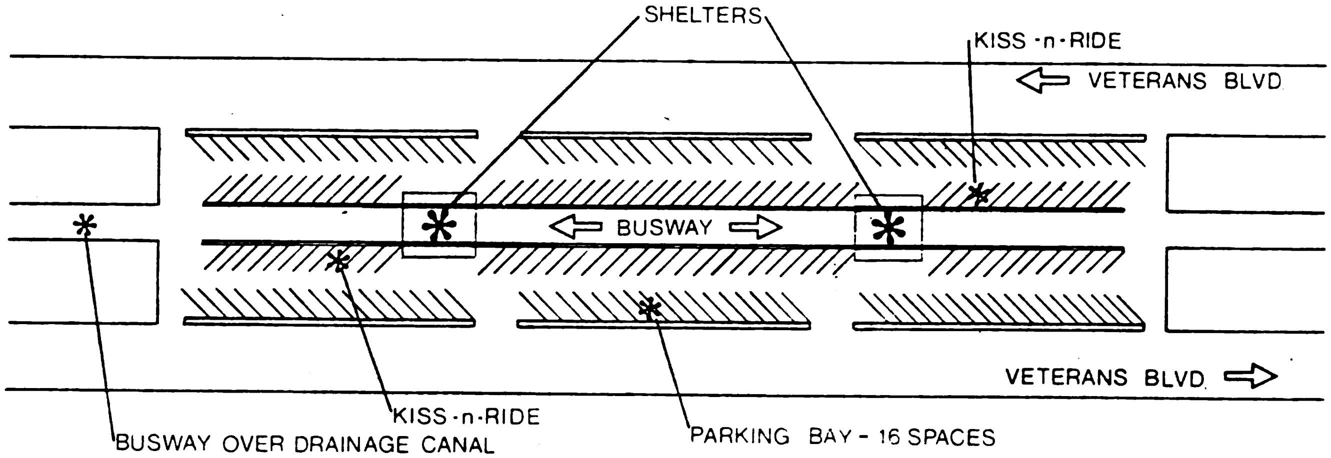

FIGURE 4 PARK AND RIDE FACILITY AND BUSWAY

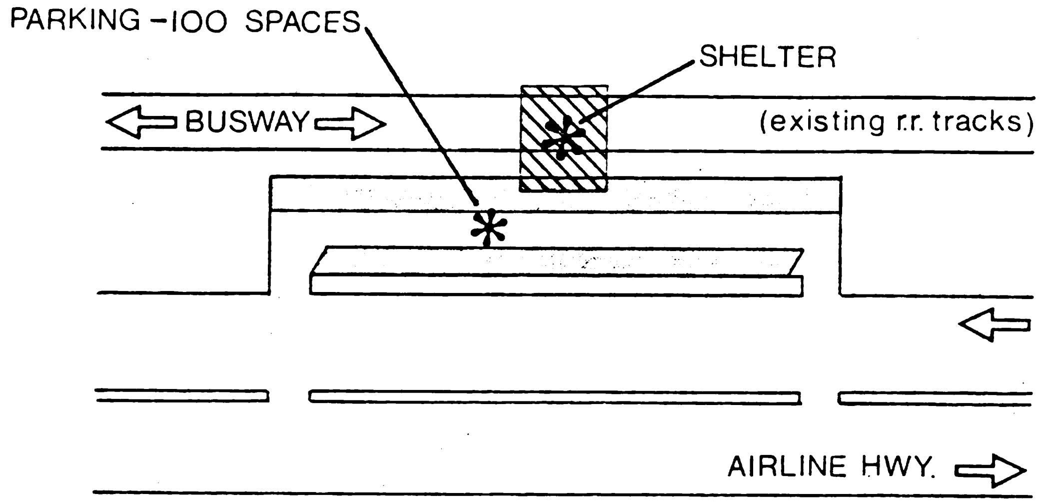

FIGURE 5 PARK AND RIDE FACILITY AND BUSWAY

this type of design, i.e., they use existing right of way, are located along major corridors, are expandable along the right of way, as demand increases, and provide ultimately for staged development of exclusive transit-ways when such a level of demand can be demonstrated. It is beyond the scope of this case study to dwell extensively on the location of particular sites and their design. Nevertheless, figures 4 and 5 provide the reader with a general understanding of the utility and integration of park and ride design in assuring efficient operation of the system.

General Description of Routes

For each proposed Park and Ride facility, round trip distance is measured to the CBD and round trip travel time calculated at a service speed based on existing conditions of automobile speeds and delays due to loading at access points.[16] The number of parking spaces at each location was factored for auto occupancy, percentage of lot occupied, and walk-up and "kiss and ride" patronage in order to determine ridership. The number of bus loads needed to transport expected ridership was then determined based on an average vehicle capacity of 50 people per bus.

These loads were spread over a peak period to determine possible headways. Then the number of buses required to maintain the desired

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[16] Based on "overall travel speeds" taken from 1970 New Orleans TOPICS Study (p. 33, fig. 29).

headway for the calculated round trip run time was determined.

When several facilities are to be served by the same bus routes, there are at least two ways to schedule the buses. One is to have all start at the most distant point and stop at every facility, operating with short headways, or to have buses originate at each stop during peak periods and run non-stop directly to the CBD. The second method is preferred since it would alleviate the problem of buses filling up at stop #1 and having no seats available for stops #2 and #3. During off peak hours one bus would serve all stops.

The buses should be equipped with two-way radios which would permit close monitoring by a central dispatcher, minimizing delays and allowing buses to be scheduled as needed in order to attract riders and maintain a high level of service. The buses would operate from 7 a.m. to 8 p.m. with the downtown shuttle operating until 12 midnight.

The equipment needed to service a route is calculated as follows:

LOCATION	ROUND TRIP DISTANCE (MILES)		SPEED (MPH)		ROUND TRIP TIME (HR.)		60 MIN.		ROUND TRIP TIME (MIN.)
1	20	÷	30	=	.66	x	60	=	40

RIDERSHIP		BUS CAPACITY		
200/hr.	÷	50	=	4 bus loads required/hr. @ 15 min. headways, 3 buses needed

Figure 6 illustrates the "proposed regional express bus system" which would tie together the chosen parking facilities along the major corridors previously identified.

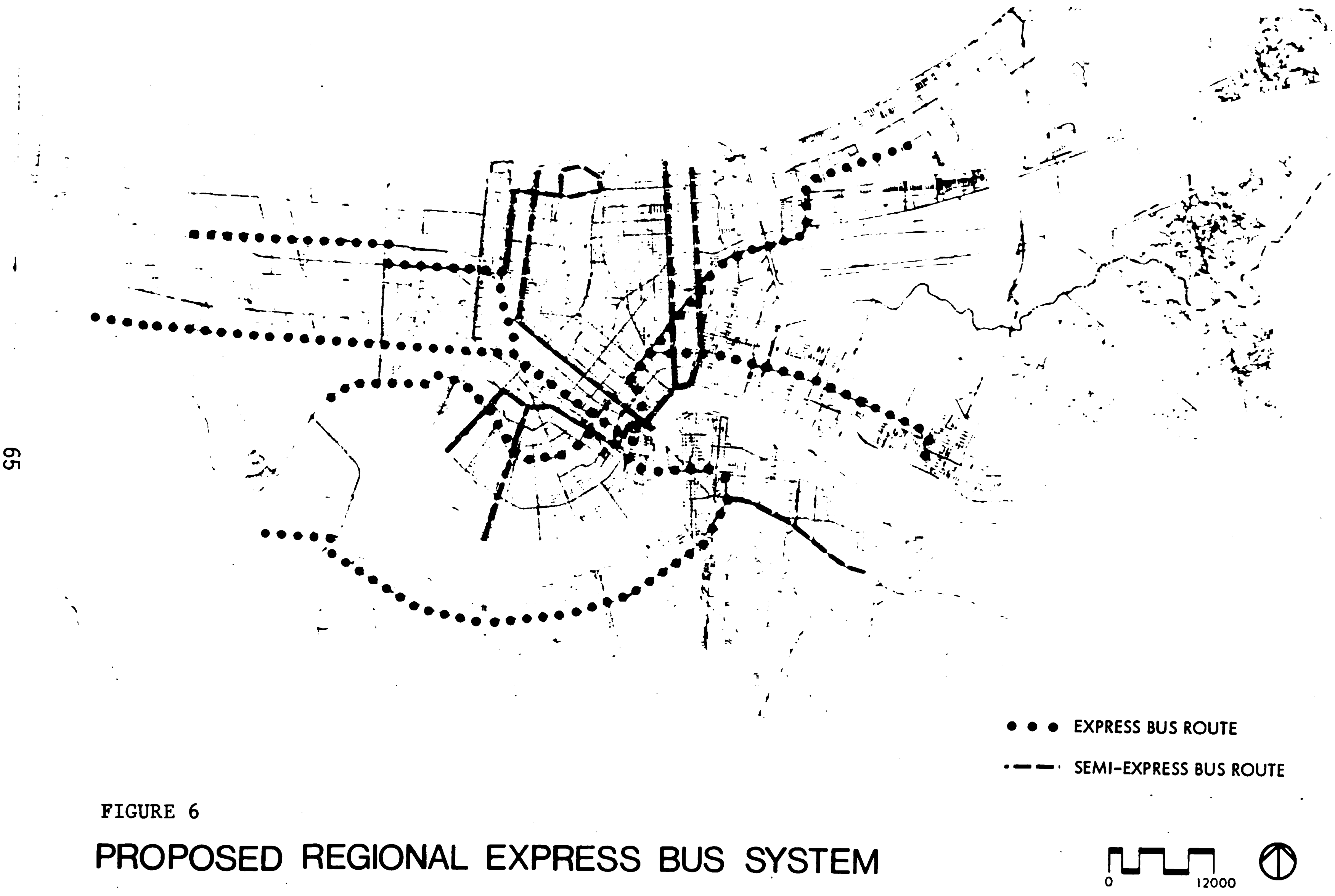

FIGURE 6

PROPOSED REGIONAL EXPRESS BUS SYSTEM

Peripheral Parking

Peripheral parking lots should be situated along the most likely travel routes, the most heavily used corridors, linking major trip origins with CBD destinations. As discussed in Chapter 4, the major difference is that these facilities are located close to the destination end of the work trip, at the periphery of the CBD, rather than near the origin end, in the suburbs. Figure 7 shows where these facilities would be logically located on the basis of the above criteria. They consist of four major parking facilities connected by shuttle bus loops.

Once sufficient demand is generated for CBD circulation between these facilities, a PRT or more highly automated transit service could be implemented. Like regional or remote park and ride, the use of buses can be made initially, with conversion to light rail or PRT when demand becomes sufficient.

Time and Cost Savings

Figure 8 compares the average travel cost by auto to Park and Ride on several express routes proposed for the New Orleans region.[17] Costs were based on travel distances from the Park and Ride sites to the CBD, assuming the auto and transit routes would be the same. The result is a considerable cost savings for the user.

While in recent years many metropolitan regions have experienced

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[17] 1. Auto costs and parking are based on 15¢ per mile and an average of $1.75 per day for parking.

2. Park and Ride is based on 60¢ round trip for bus ride and 50¢/day for parking.

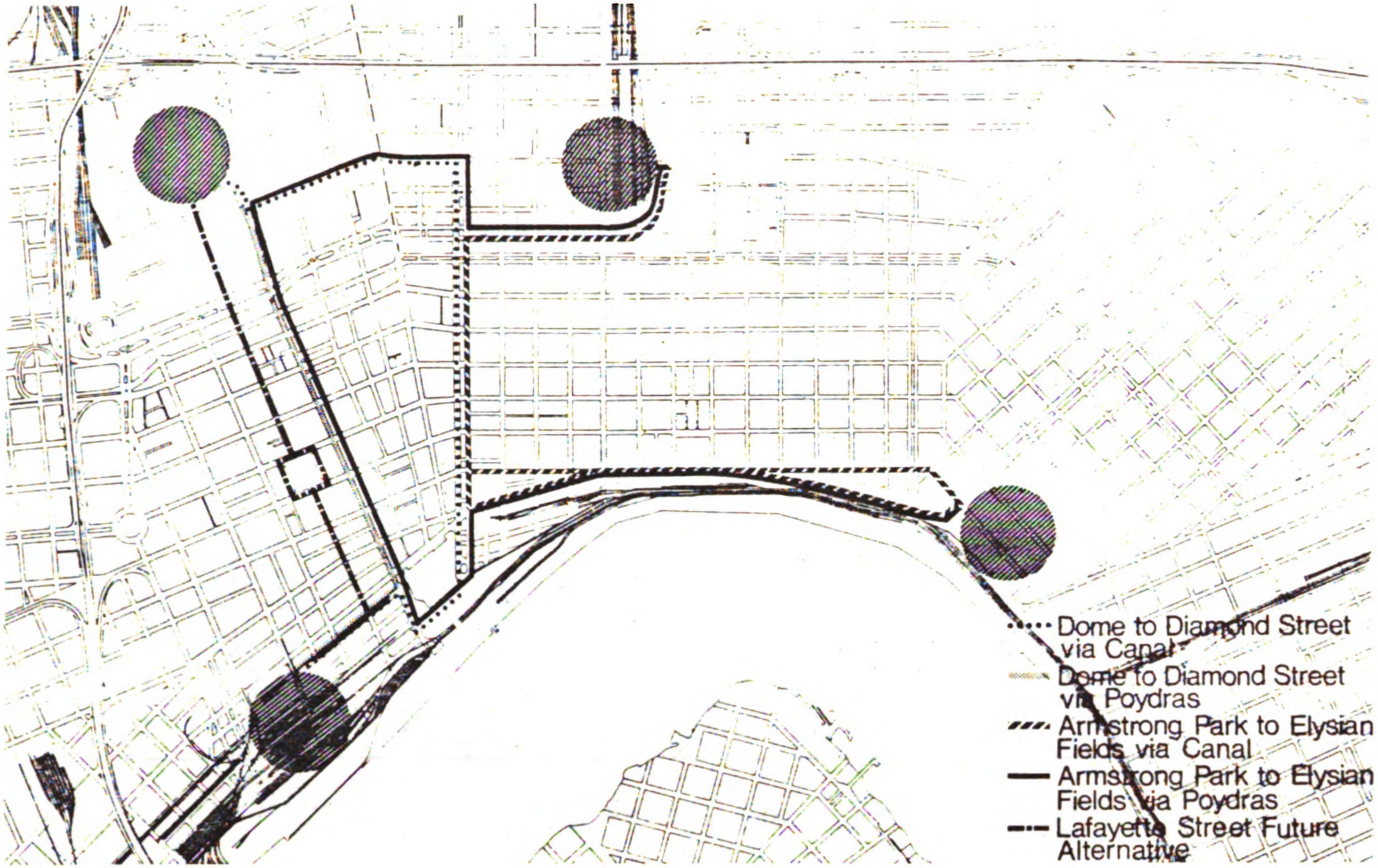

FIGURE 7 PERIPHERAL PARKING LOCATIONS AND SHUTTLE BUS DISTRIBUTION SYSTEM

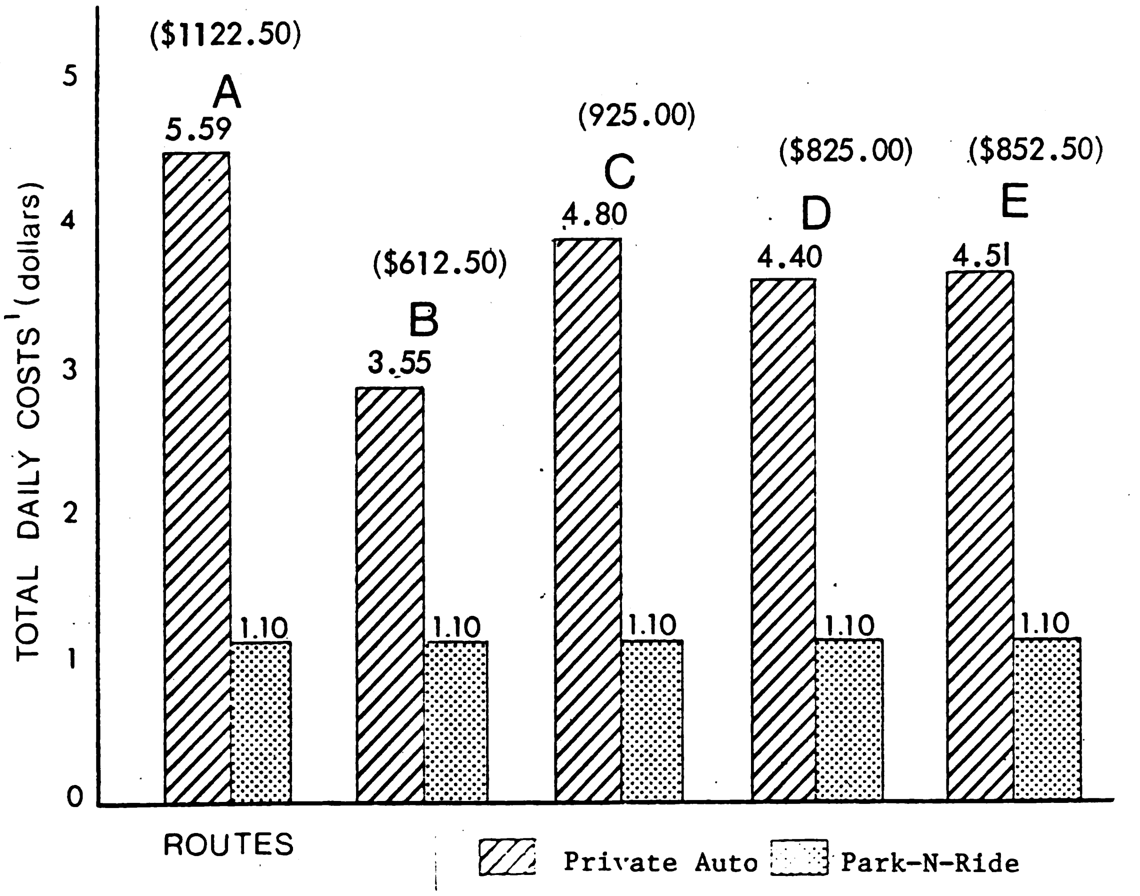

FIGURE 8 COST COMPARISON BETWEEN PRIVATE AUTO AND PARK AND RIDE

(000) - Annual Cost Savings

[1]Costs include operating costs, fares, and parking fees. Daily cost to the user from most remote point on several routes to the CBD.

a gradual decline in transit ridership, the immediate attractiveness of Park and Ride in terms of costs savings and convenience should result in considerable stabilization of the projected decline in regular transit patronage. Figure 9 illustrates the reduction in decline of ridership which could be expected by gradual implementation of a Park and Ride system in New Orleans over several years.

Cost and Revenue Estimates

Having shown the cost savings involved for the users of the Park and Ride system, the next step is to describe the costs to the operators and the revenues which they can anticipate with which to pay those costs. These costs and revenues can be estimated on the basis of past experience in building parking facilities and in operating express buses. The following cost and revenue factors can be taken into account for each of the routes and parking facilities required.

For the routes there are capital costs (the buses), operating costs and revenues from fares. For the sites there are capital costs for construction of the parking lot facilities. The cost of one custodian at each lot comprises the only operating cost. Additional trash pickup would be handled by city or parish sanitation crews on their regular routes. The problem of abandoned autos would be handled by the police. Grass mowing would be handled by regular crews from the Roads and Bridges Department in Jefferson Parish and Parkways Commission in Orleans Parish. Each lot earns revenues from the parking meters with fares paid on board the buses.

What follows is a description by site and by route of each of these

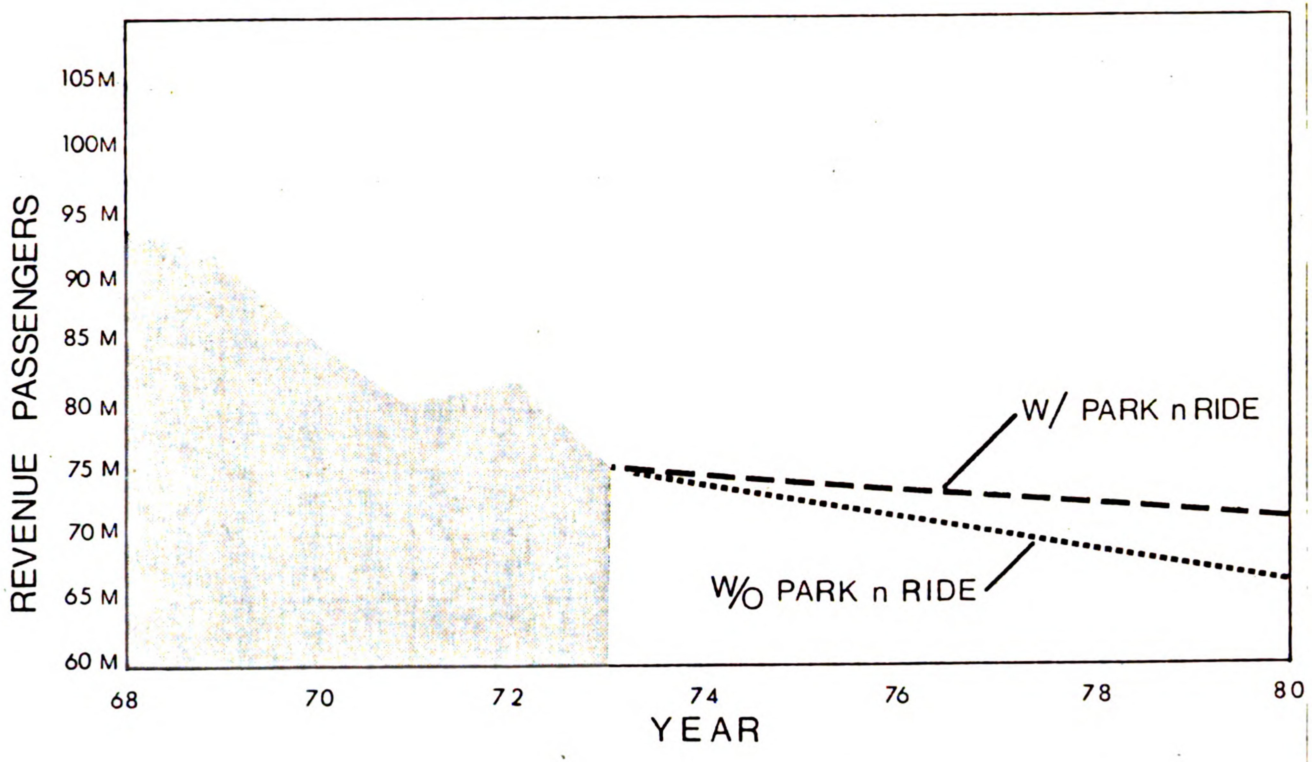

FIGURE 9 REGIONAL TRANSIT RIDERSHIP PROJECTION

SOURCE: NOPSI, La.Transit Co.,Westside Transit Co.and Curtis and Davis.

costs.

Capital Costs

Capital costs consist of the acquisition of land and the cost of new buses required to serve the new routes. While it is possible that buses may be available in the existing transit fleets of the region which could be used on the new routes, the cost requirements for new buses are estimated. The number of buses required is based on the round trip run time to each site and the headway which is considered desirable. The number of buses calculated for each route is multiplied by a current cost estimate ($65,000) to obtain total capital cost for each route.

Route Operating Costs

Operating costs are based on an estimate of $15/vehicle hour. This amount includes fuel, maintenance, and labor costs. Vehicle hours are calculated by dividing one hour by the headway to determine the number of buses per hour operating from each Park and Ride site. Buses per hour are then multiplied by the peak period (1-1/2 or 2 hours); this is multiplied by two to include the afternoon return trip and one bus per hour is added to serve the route during off peak hours and two or three hours after the P.M. peak. The resulting number equals the total bus runs for one day for that route. Multiplying this by the round trip time to each site gives the total vehicle hours; multiplying again by $15/hour gives the estimated daily operating cost. Yearly operating cost can be calculated using 250 days/year, an average number of work days. Buses will operate from 7 a.m. to about 8 p.m., except the downtown shuttle which will operate until about 12 midnight. The downtown garages will operate all night and the outlying lots using meters will remain open all night.

Route Revenues

Revenues are estimated based on a round trip express fare of 60¢. Ridership has been estimated by factoring the number of parking spaces by .8 for lot occupancy, 1.4 for auto occupancy, and 1.25 for walkers and "kiss and ride" patrons. A number of possible combinations of lot occupancy, auto occupancy, walkers and "kiss and ride" levels could in fact occur. Assuming a minimum possibility of 70% lot occupancy, 1.2 car occupancy, and 10% walkers and kiss and riders, and a maximum of 90% lot occupancy, 1.4 car occupancy, and 30% walkers and kiss and riders, the range of transit riders generated /100 car lot could be between about 92 and 164. The reader could adjust the revenue estimates accordingly to suit his own assumptions. However, a realistic intermediate estimate in the author's judgement would be about 140 transit riders generated/100 parking spaces. This takes into account the historical auto occupancy rate for the region, and hopefully a high balance of parkers, walkers, and kiss and riders. Attributing a 60¢ fare to each of the estimated riders, the resulting yearly revenue from fare collection on buses is about 1.5 million while operating costs would be about $2 million. The revenues collected from the parking lots would be approximately $700,000/year while operating costs for the lots would be about $464,000/year. Total combined revenues would be around $2.2 million/year with operating expenses of $2,464,000. This will result in a deficit of about $264,000/year.

Park and Ride Capital and Construction Costs

Construction costs were based on area requirements, as in the following example.

Construction Costs

(in 1975 dollars)

Construction of three (3) 160 car parking lots includes:

a.	Grading, landfill, asphalt paving	$208,800
b.	Concrete curbing and stripping	5,610
c.	Lighting	1,800
d.	Miscellaneous (landscaping, etc.)	4,800
e.	Bus access lanes	136,362
f.	Three (3) passenger shelters	18,000
g.	Acquisition of property	NONE
h.	10% contingencies and engineering costs	37,537
TOTAL PROJECT		$412,909

Park and Ride Site Operating Costs

Operating costs consist of maintenance of each of the lots. Only one custodian should be needed at each site, working for eight hours at a daily rate of $32.00. The cost of supplies is estimated at $20/day, bringing the total maintenance costs to $52/day or

$13,000/year.

Site Revenues

Revenues for each Park and Ride site can be calculated by multiplying each occupied parking space by the meter rate for all-day parking. This rate is estimated at 50¢. Using a rate of 80% occupied parking spaces on a given day, meter revenues have been determined for each site and multiplied by 250 to arrive at a yearly revenue. Considering the relatively low cost required to maintain the Park and Ride facilities, the anticipated revenues would offset the operating costs by a considerable amount.

Capital Costs (routes)

Route A = 12 buses x $65,000/bus = $780,000

Operating Costs (routes)

Route A	Bus Runs	Time/Run	Vehicle Hours Runtime	Vehicle Dead Time	Daily Costs ($15/hr.)	Yearly Cost (250 days)
Sites 1	12	.93 Mins.	11.16	4	227	56,850
2	12	.85 Mins.	10.02	4	210	52,575
3	12	.72 Mins.	8.64	3	172	43,650

Revenues (routes)

Route A	Daily Riders x	Round Trip Fares =	Daily Revenue	Yearly Revenue
	672	60¢	$403.00	$100,750

Operating Costs (Sites 1, 2, 3)

Maintenance/lot = $13,000 x 3 = $39,000

Maintenance Costs

1 Custodian working		
8 man hours x $4/hr.		$ 32/day
$32/day x 250 days		$ 8,000/yr.
Supplies, miscellaneous	=	$ 20 day
$20/day x 250 days	=	$ 5,000/yr.
TOTAL		$13,000/yr.

Revenues (sites) @ 80% Occupancy

Daily Revenue		Work Days/Year	= Yearly Revenue
$64/day	x	250	= $16,000
			x3
			$48,000

Capital costs would be split 80% UMTA/20% local. Operating costs for the example route and sites would be $192,075; revenues would be $148,750. The yearly deficit would be $43,325. While this particular example represents only 1/6 of the total proposed system for the New Orleans region, the total deficit for the system would not be great, certainly within the ability of the region to subsidize. Such a deficit would only amount to about 20¢/capita/year.

A breakdown of the capital and operating costs for the total system would closely approximate the estimates provided in Tables 7 and 8. These costs are spread over a five year period to illustrate how the cost would be distributed if the system were built in stages. This would be a realistic assumption. The smaller parishes would probably contribute a small portion of the total cost. Also, it should be pointed out

Table 7

Five Year Capital Costs for Total System by Parish

YEAR	TOTALS	UMTA SHARE 80%	ORLEANS 20%	JEFF. 20%	ST. BERNARD 20%	ST. TAMMANY 20%
I	11,773,277	9,418,622	1,951,282	321,627		81,746
II	975,000	780,000	195,000	-	-	-
III	851,237	680,990	-	170,247	-	-
IV	14,793,022	1,120,818	224,558	-	56,646	-
V	6,865,032	4,492,026	924,819	448,187	-	-
	$21,865,568	$16,866,056	$3,295,659	$940,061	$56,646	$81,746

Table 8

Five Year Regional Operating Costs and Revenues for

Total System @ 80% Operating Capacity

YEAR	COSTS	REVENUES	PROFIT (LOSS)
I	$ 947,175	$ 849,750	($ 97,425)
II	$1,513,675	$1,324,750	($188,925)
III	$1,708,150	$1,417,750	($290,400)
IV	$1,844,050	$1,643,750	($200,300)
V	$2,463,363	$2,199,300	($264,063)

that the estimated $264,000 deficit shown in Table 8 represents the assumptions that 80% of the parking lots will be occupied on the average, that these will be an average of 1.4 persons/auto driving to the parking lots, and an additional 25% transit riders will walk to or be dropped off at the express bus stop. If in fact the lot occupancy is 90% or even 100%, or the other ratios increase, the deficit would be much less. If the ratios for some reason are less than expected, the deficit would be much greater. However, the figures represented in Table 8 are very reasonable expectations in the author's judgement, and should be well within the willingness of the metropolitan region to subsidize. In terms of the significant cost savings to the commuter, the potentially great reduction in traveltime, the reduced congestion on the major corridors accessing the CBD, reduced parking requirements in the CBD, possible elimination of the need for extra family cars, and many other factors, the utility of the system is well worth a very modest subsidy. At 20¢/capita/year, the benefits to the region far outweigh the cost.

Coordination with other Transit Improvement Recommendations

A regional express bus system represents an important intermediate level element of an expanded regional transit system. It ties suburban living concentrations with central city activity concentrations, especially work-related activities. It is fed at both ends by regular line-haul buses intersecting the major corridors and by special shuttle buses serving specific high-density activity centers. It provides a network of medium to high speed transportation along corridors which will support and require higher levels of service than local buses, but where the demand is not sufficient to justify a capital intensive, high capacity, fixed guideway system. When adequate capacity and level of service are provided, with good design and construction of access ramps to the main roadway, the service offered by the Park and Ride parking and express bus operations can be attractive and provide a competitive alternative to the automobile for the commuter.

Transit improvements are currently programmed for implementation by the City of New Orleans. These include two 500 vehicle Park and Ride lots on the West Bank of the Mississippi River, a Park and Paddle lot near a major ferry landing, a new ferry at each of the present river crossing locations, and replacement of many of the older buses.

New Orleans is also in the process of preparing applications for submission to UMTA for funding of Park and Ride facilities at two locations on the periphery of the CBD, two locations in Eastern New Orleans, and one site at a major central city interchange. The peripheral sites will each serve from 1000 to 3000 vehicles; the Eastern New Orleans sites will serve 200 vehicles each, and the major central city interchange site 500 vehicles. The Louisiana Superdome has recently opened and will provide 3000 spaces for peripheral parking in its garages.

In addition to these programmed and planned improvements, the most recent Transit Development Program recommends bus replacements, route improvements, service additions, ferry expansion, CBD shuttles, a Canal Street transit terminal, and other short-term improvements in the regional transit system. Park and Ride can be coordinated directly with some of these elements, e.g., route additions and the CBD shuttles, and indirectly with others to bring about a continued rise in the level of transit service to residents and visitors to the New Orleans Metropolitan region.

Figure 10 shows the elements of a five year transit improvement plan which tie into the regional express bus system.

The preceding case study of New Orleans was intended to illustrate the potential for improving regional transportation service, particularly for peak hours work trips, at relatively low cost.

The next chapter will discuss the application of a similar approach to other cities.

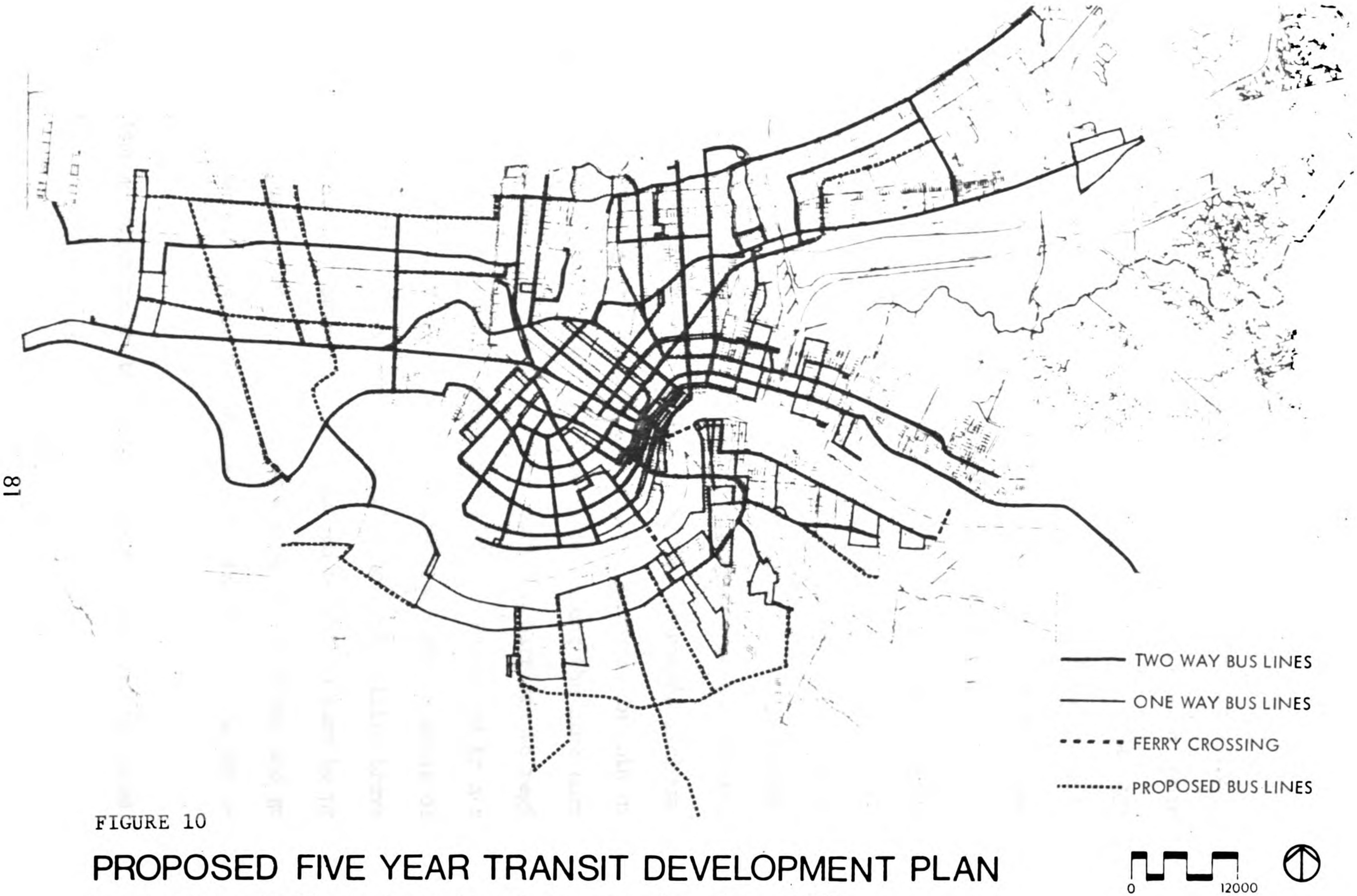

FIGURE 10

PROPOSED FIVE YEAR TRANSIT DEVELOPMENT PLAN

Source: Transit 80, Regional Planning Commission, June, 1974.

APPLICATION OF METHODOLOGY TO OTHER MEDIUM-SIZED CITIES

The point should be made that in defining "medium-sized urban areas," density and geographic characteristics are more important than population alone. "Park and Ride" is an example of a package which is suitable particularly for urban areas composed of geographic configurations conducive to major corridor connectivity between moderately dense subcenters. Certain standards have been previously mentioned. For example, the park and ride origin should be near a residential concentration of at least 1200 persons/square mile, adjacent to a major transportation corridor, an area with a high percentage of one-car households, and should ideally be located 4 to 10 miles from the destination. The destination should be an activity center which employs at least 10,000 employees. These, of course, represent minimum densities. As the service areas and activity centers increase in both size and density, system capacity can be increased along the same corridors.

While geographic elements may represent barriers to regional travel, they also pose unique problems which can be solved by a system such as "park and ride." New Orleans, again, is a good example of this. The Mississippi River forms a major barrier to metropolitan travel. However, the demand for river crossings can be met in part by providing adequate parking space on the origin side of the river and good express transit service across the bridge or by ferry into the CBD on the other side.

The approach taken thus far in this thesis has not involved complicated methods or procedures, but a very straightforward means of identification and cross-classification of relevant planning components leading to the development of a sound package or plan of action. It is important that planners orient their thinking more to implementable programs than to theoretically "good" plans. This thinking should recognize the constraints common to most large or medium-sized cities and those peculiar to a given urban context. In medium-sized cities, the constraints include, in addition to energy limitations and financial shortages, lower densities than the nation's largest cities. These cities are in the difficult position of maintaining adequate public (as well as private) transportation between service centers not sufficiently dense to justify high-capacity rail systems nor of low enough density to disregard the need for supplementary transportation altogether. In this type of situation, transportation improvements must meet the requirements of low cost, energy conservation, adaptability to varying densities, and staged development (to meet travel demands as they increase in the future). These requirements may be modified as the specific situation requires. Nevertheless, the low cost improvements identified in chapter two and the action categories and criteria used in chapter three can be applied to most medium-sized urban areas. The package developed around the Park and Ride framework should contain elements appropriate to each urban area. While Park and Ride represents a good package of basic elements for regional transportation development in New Orleans, the package or plan for each urban area must be tailored to its individual needs. The results of the exercises in chapters two and three can be used in conjunction with the goals and objectives of each urban area to develop the best action package for that area.

The basic procedure can be outlined as follows:

(1) Select the preferred and feasible alternatives based on their individual and complementary adequacy,

(2) Cross-classify these alternatives against a wide range of criteria of effectiveness,

(3) Select alternatives which are most compatible with the goals and objectives of the region, and

(4) Translate feasible concepts into workable systems for the particular urban region.

A city of less than 250,000 or more than one million population could fall into a category of eligibility for the analysis which has been discussed if it has any problems which can be solved or alleviated by the complementary low-cost improvements discussed in earlier chapters. The important pivotal point is the political decision-making process. The planner must generate alternatives which are technically adequate. Then, it becomes essential that decision-makers evaluate the alternatives in terms of political realities and participate with the planner in formulating a workable and implementable program package.

SUMMARY AND CONCLUSIONS

There seems to be a growing recognition on the part of metropolitan governments and transportation authorities that basic transportation networks cannot go on expanding indefinitely. Most regions have well-developed highway and street systems which were essential in the age of expanding auto use. The basic framework already exists upon which new systems can be constructed. There is a growing realization that the kinds of problems which exist in urban centers today cannot be solved by opening up major new corridors or by injecting massive doses of public funds into capital intensive projects. More can be accomplished in improving transportation capacities by spending relatively less money, but in spending it more wisely for improvements to the existing networks.

Transit development need not include large, complicated, untried technologies in order to make dramatic progress. Development can be staged so that service is improved, as much as possible, with conventional transit and modifications, with the capability of transformation as demand and cost considerations allow.

This thesis outlined a procedure by which any urban area, but particularly those of medium size and moderate density, could construct packages of implementable low-cost transportation improvements. Basically, this procedure involves identifying useful individual elements, choosing the elements which complement or assist each other, and evaluating the strongest complementary action groups against a range of operational and institutional criteria. Actually performing this evaluative step, it was determined that the alternatives which meet the evaluation criteria most successfully were of the positive incentive type, such as measures to increase vehicle occupancy and transit and to facilitate flow of these vehicles. The less acceptable alternatives were the negative or disincentive measures such as parking taxes, tolls, road user fees, or vehicle-free zones. While disincentive measures may be essential in the long run to achieving reduced vehicle travel, action packages should emphasize positive measures wherever possible. However, all of these categories should be evaluated by regional and local decision-makers in terms of the goals and objectives which have been adopted for the metropolitan region. At this point in the procedure, a package of actions can be created by the planner and decision-maker working together.

The concept of "park and ride" and its application to New Orleans was discussed in terms of its appropriateness as a framework for future regional transportation development. Methods for estimating demand and capacities, the location of parking sites and express routes, estimated costs and revenues, and assumptions relating the new elements to the existing system were all discussed in terms of an example of a total package which would be desirable to achieve. Obviously, in consideration of varying densities and the presence or absence of major corridors and other factors, the package would be different for each urban area. Once an agreeable action package is developed, it can be incorporated into the Transit Development Program for the region and scheduled for implementation in acceptable stages.

The most effective low-cost improvements discussed were those which reduce the number of vehicles on the roadway system while increasing the occupancy level of the remaining vehicles (cars, vans, and transit). Correspondingly, measures must be taken to improve the flow of these high-occupancy vehicles by giving them preferential treatment, while penalizing other traffic by means of exclusion from certain areas, at certain times, or by means of road taxes or parking penalties.

A system has been developed for the New Orleans region which involves primarily the incentive approach. The Park and Ride systems are designed to improve convenience, reduce travel time and cost along with parking time and cost to the user, and to reduce the overall vehicle travel on the system. Implicit in this incentive program is a recommendation for bus-actuated signals, bus priority regulations, exclusive bus lanes, carpool programs, better routing and scheduling of existing buses, and restrictive parking and roadway user taxes. These devices may be supplemented by further traffic restrictions and disincentive measures as the need arises, although considerable care should be exercised in considering the negative consequences which might result from improper use of disincentive measures.

Future transportation improvement considerations should involve a continuous reappraisal of the costs and utility of the many options which are open to the metropolitan region. Maximum use should be made of the existing corridors serving major growth termini. The long-range view should include the possibility of reducing the need for urban mobility by promoting the development of more self-sufficient centers of growth. Any new corridors which are developed must include provision for transit and other alternative modes. New freeways must be constructed with the possibility of stage development, allowing exclusive lanes for buses to be easily converted to other mode possibilities as new technologies are developed and as demand increases.

Long-range plans should exclude none of the techniques reviewed at the beginning of this thesis, and any other techniques which are developed in the future should be examined in terms of the essential criteria and goals for the particular region.

Transportation planning in the future must follow a course of systematic, conservation minded, appraisal of a wide range of alternatives. The traditional transportation modelling process, with its inherent assumptions of population and employment, and consequently trip-making growth, must give way to an emphasis on public policy objectives and the possibility of deliberate containment or management of vehicle trip-making. The assumption can no longer be made that projected demand must be met, at least not for private vehicles. Plans to meet the trend-line projections of vehicle trips are self-defeating. They create future congestion even as means are being implemented to alleviate current problems. Instead, future plans should consider alternative means of moving people, or creating better communication systems and growth patterns to reduce the necessity for so much urban mobility.

BIBLIOGRAPHY

American Public Transit Association. Transit Journal. February, 1975.

American Society of Civil Engineers. Specialty Conference. New Approaches to Urban Transportation Needs. March 31, 1971.

Automobile Manufacturers Association. The Potential for Bus Rapid Transit. (Prepared by Wilbur Smith and Associates, Columbia, S.C.). February, 1970.

Curtis and Davis Architects and Planners. New Orleans CBD Transportation, 1974-2000. August, 1974.

Development Research Associates and Wallace, McHarg, Roberts and Todd. Tech. Report No. 1. Preliminary System Design. A Public Transportation Plan for Colorado's Regional Transportation District. June, 1973.

Hartgen, David. Preliminary Research Report No. 36. Forecasting Remote Park and Ride Transit Usage. N.Y. State Dept. of Transportation. December, 1972.

Highway Research Board. Special Report No. 87. Highway Capacity Manual. 1965.

Kaiser Engineers. Presentation on Transit Technology to Governor's Citizens Advisory Committee. New Orleans. May 17, 1973.

Keck, Carol, and Peter Liou, Preliminary Research Report No. 56. Forecasting Demand for Peripheral Park N Ride Transit Service. New York State Department of Transportation. March, 1974.

Louisiana Department of Highways. A TOPICS Study in the New Orleans Metropolitan Area. 1970.

Michigan Department of State Highways and Transportation. Dial A Ride Transportation. Status Report. October, 1975.

Regional Planning Commission for the Parishes of Jefferson, Orleans, St. Bernard and St. Tammany (Louisiana). Transit 80, Short Range Transit Improvement Program. (Prepared by Curtis and Davis Planners). June, 1974.

__________. Transit 81, Short Range Transit Improvement Program. March, 1975.

Schaefer, Richard, George Tanner, and David Hartgen. Preliminary Research Report No. 43. Surveys of Park and Ride Transit Demand. N. Y. State Department of Transportation. March, 1973.

Southern California Rapid Transit District. A Comprehensive Plan of Preferential Facilities for High Occupancy Vehicles. (Prepared by Wilbur Smith and Associates). March, 1974.

Tanner, George, and Rose Barba, Preliminary Research Report No. 44. Park and Ride Transit Service: Some Guidelines and Considerations for Service Implementation. N. Y. State Department of Transportation. April, 1973.

The Urban Institute. Para-transit: Neglected Options for Urban Mobility. Washington, D.C. June, 1974.

Urban Mass Transportation Administration. U.S. Dept. of Transportation. Guidelines to Reduce Energy Consumption Through Transportation Actions. (Prepared by Alan M. Voorhees and Associates). May, 1974.

________. Low Cost Urban Transportation Alternatives: A Study of Ways to Increase the Effectiveness of Existing Transportation Facilities, Vols. I & II. (Prepared by R. H. Pratt and Associates). January, 1973.

________. Statement of Position of the Federal Highway Administration on the Reservation of Freeway Lanes for Buses. August, 1967.

Urban Transportation and Planning Associates, Inc. Park N Ride, Park N Paddle Feasibility Study. June, 1973.