SUBURBAN TRANSIT PLANNING AND FORECASTING

Daniel E. Benson*, Wilbur Smith and Associates

Problems and policy issues of particular concern to suburban transportation planners are identified, including dispersed trip-making, high income and automobile ownership, low densities, significant transit-dependent population, increasing peak-hour freeway congestion, growth policy issues, and short-term availability of less expensive or nonunion labor. Experience in Orange County, 4 areas of Los Angeles County, and Chicago suburbs is discussed. Unique suburban approaches in the planning process are identified, and forecasting problems are discussed. For forecasting implications, 3 high-quality suburban-to-CBD transit services are compared with the range of calibration values for the LARTS model in southern California. Variables compared include the system characteristics in the marginal utility mode-choice model, socioeconomic characteristics of trip-makers, attitudes of trip-makers, and resultant trip-making behavior. The last category focuses on transit's market share, which appears to be a more appropriate planning statistic than the percentage of all trips using transit, as called for in mode-choice models. Some uniquely suburban transit organizational and planning process issues are discussed.

•EVERYONE is familiar with the suburban stereotype of endlessly sprawling single-family homes whose owners use 2 or 3 cars to make 6 to 12 trips per day to downtown jobs, second jobs, schools, and shopping. If a suburban area has any buses at all, they are used by the elderly, children, and domestic workers.

The problem of achieving radically improved levels of transit ridership indicates a need for significantly improved service levels—short headways, possibly door-to-door service, and even preferential treatment. Suburban public officials are beginning to ask for transit service that can attract the owners of 2 cars. In addition, a large number of handicapped, elderly, young, and economically depressed individuals are being identified among these automobile-oriented families. Both high-speed, uncongested commuter service to the central business district for drivers and local service for transit-dependent groups are needed. Experience with these transit problems in Orange County, 4 areas of Los Angeles County, and Chicago is outlined in this paper.

PROBLEMS AND POLICY ISSUES

Dispersed Trip-Making

Travel patterns in suburban areas are generally scattered. Except for some concentration to the CBD, to the airport, or to large shopping centers and industrial parks, travelers do not concentrate in corridors where they could be served by a bus or rapid transit system. Automobile dependency and freeway construction have caused accessibility to become distributed rather evenly throughout the suburbs. We need to find which suburban travel markets have the best potential for efficient transit.

High Income and Automobile Ownership

As their incomes rise, central city residents move to the suburbs and acquire a second car to maintain their mobility. Local-service bus routes simply cannot com-

*The author was with the Orange County Transit District when this research was done.

pete with automobile travel speeds for a resident who has a car in her or his garage and a place to park at the destination.

Low Densities

Standard-sized buses are designed to concentrate trips along street corridors. This is difficult in the suburbs because of the predominance of single-family homes on large lots. Fewer passengers results in less frequent service, which in turn discourages patronage.

Suburban Transit Operations

Remaining operators of bus services in the suburbs generally have had old vehicles, which are poorly maintained and unreliable.

Governmental Responsibility

The fractionalized local governments in suburban areas have been too small in size and too short of funds to help transit. Metropolitan transit operators and metropolitan planning agencies have in the past concentrated on the more critical problems of bus operations in the central city, where they have recognized that the higher densities and lower incomes create the greatest demand for transit and where any new funds are automatically sunk into higher salaries and operating costs. Only in the last few years have these agencies recognized suburban accessibility problems, and the results are evidenced in ridership.

Large Transit-Dependent Populations

Regardless of the high income and automobile ownership in the suburbs, a large number of transportation-disadvantaged persons must depend on others or simply not make trips when they need to travel. Curry (1) reported on this need, and the high populations in these groups indicate a substantial need, regardless of the scattered distribution.

Peak-Hour Freeway Congestion

Even in suburban counties, freeway construction programs are being slowed or stopped by local officials and lawsuits. Congestion on existing freeways in the rush hours is spreading deeper into suburbia. The growth-inducing experience of freeways contributes to the congestion and leads to the conclusion that many of these freeways cannot possibly retain reasonable peak-period speeds unless attractive transit service can divert that number of drivers that makes the difference between a free-flowing freeway and a congested one.

Expanding Transit Need

Growth and development create a demand for improved transit service in newly subdivided areas. This has especially been recognized in new communities, some of which have included transit services in their planning and investment programs. Under these conditions, above-average transit usage has occurred if the short trips and nonwork purposes involved are considered.

Air Quality and Energy Conservation

Regional transportation planning agencies have recognized that, to produce a significant improvement in air quality in the region, a significant improvement in transit service and disincentives to the car may be needed as part of the short-range transportation plan. In fact, such plans for most major metropolitan areas have already been prepared by the U.S. Environmental Protection Agency. Because a significant portion of the vehicle-miles of travel in a region occurs in the suburbs, they are being included in restrictions on distribution of gasoline, reductions in parking, and replacement of the travel by bus and car-pool lanes on all major streets and freeways. However, few buses are available to accommodate a mode shift. To reduce air pollution, congestion, and energy consumption, suburban transit districts may have to use freeways with or without priority treatment if they hope to seduce suburban drivers from cars. Fixed bus routes on local streets cannot compete, and only a few passengers per bus times a few bus-miles per gallon equals the same passenger-miles per gallon that automobiles achieve.

Transit Industry Efforts

Transit operators are beginning to recognize the importance of a total marketing program in building ridership. Assisted by expanded capital grant programs of the Urban Mass Transportation Administration, some transit districts are developing a comfortable and attractive suburban product and are promoting their services agressively with significant advertising budgets. Without long-standing transit habits to sustain patronage as in central cities, new services must be aggressively marketed.

State Legislation

Legislators in recent years have done much to stimulate interest in suburban transit by providing capital or operating subsidy funds to metropolitan or suburban agencies. In states such as California that provide funds to transit districts, suburban riderships are expanding.

Labor Costs

Small fleets of buses run by suburban municipalities are often able to save 25 to 40 percent of central city operating costs by paying lower salaries (2). Larger regional and suburban transit districts generally cannot maintain such a situation for long.

SUBURBAN TRANSPORTATION PLANNING PROCESS

Certain key patronage forecasting elements of the transportation planning process are being given increased attention and funding in suburban studies and in suburban elements of regional transportation network plans. Regional network plans have been prepared everywhere, but increased attention must be given to the suburban elements of those plans, particularly because the forecasting and mode-choice models are less reliable in suburban areas than they are in the central city. Bus improvement studies whose scopes are entirely within suburban areas are receiving increased attention because of the need to serve transit-dependent groups and commuters who work in the suburbs. In the past, suburban planning efforts concentrated on line-haul systems to bring people to their jobs in the city and neglected the internal trips. The following elements of the planning process focus on patronage forecasting problems that do not generally receive sufficient attention in studies of metropolitan freeway corridors or central city rapid transit systems, or if they do, they are not sufficiently important to the agencies.

Inventory of Existing Transit Operations and Ridership

This traditional element of a transit plan will receive less attention than it has in the past in suburban studies. Existing high-fare, dilapidated transit operations carrying few riders on routes that were successful 20 years ago may only create confusion in the transit study by emphasizing obsolete use. But such an analysis in a central city transit improvement study may be useful in projecting ridership on a faster bus or to a rail line. New buses, lower fares, and more frequent service are primarily dependent on completely new ridership coming from new routes designed to serve today's transportation patterns.

Suburban Technologies

Because of the problems with suburban transit in the past (dispersed trip-making, high automobile ownership, and low densities) more modern buses with frequent operating schedules will be needed to attract drivers. For the major corridors, competition between bus and rail modes continues. Benefits of rail rapid transit include comfortable operation, short headways, and reliability. Bus rapid transit provides its own feeder service so that no transfer is required and can be readily implemented on freeways. Because of its flexibility as a feeder, the express bus can serve a broad area of trip origins with several distributor routes focused on a line-haul busway to the CBD. Generally, a bus can operate on a freeway with exclusive lanes if it is mixed with car pools, if there is a significant bus volume (30 to 60 buses/hour), or if it is on a bypass for a metered ramp. A much lower investment cost may be needed for bus than for rail rapid transit (3). On the other hand, rail rapid transit has a much lower operating cost because it can be automated and several cars can be coupled to eliminate the need for a driver for each vehicle. Of course, its investment cost is higher than for buses on an existing freeway.

Variations on the line-haul technologies include use of rapid transit with a demand-responsive feeder system. This would provide high-quality and flexible door-to-door feeder service and could also serve local trips. Cost is an important consideration, but an equally important consideration is the type of operation that will maximize ridership. Although rail transit is penalized by change of mode to the feeder, the bus on the freeway disperses feeder routes so that frequency of service drops, and one or the other may generate more ridership, depending on local conditions. The primary virtue of demand-responsive service is that it is so similar to automobile or taxi operation that it generates more ridership than a fixed bus route. Rather than operate on fixed routes and schedules, which in suburban areas would have to be expensive to be frequent because of the low density, demand-responsive vehicles respond to a specific telephone call to pick up the prospective rider and deliver him or her to the door of the destination or a line-haul station. A disadvantage to either mode is that its higher operating cost as compared with poor fixed-route service requires a higher fare; but suburban income is also higher, and subsidies or free fares could be provided directly by welfare agencies.

Alignments

Alignments for high-speed rapid transit lines either make use of existing freeway lanes or ramps or may take over existing linear rights-of-way, such as those of old interurban railroads and high tension power lines. This approach minimizes the capital cost for alignment, but may put a transit line where the people are not and thus reduce patronage. A suburban corridor, however, must depend primarily on park-and-ride and feeder bus service anyway because the area will not be concentrated enough to generate significant walk-in traffic.

Bus-on-freeway proposals must give strong consideration to the potential for exclusive bus lanes or ramp-metering bypass lanes in terms of the potential detrimental impact on freeway operations and disincentives for automobile use. A recent NCHRP report describes nationwide experience with busways (3).

Sketch Planning

The theoretical basis for sketch planning is complex, but this paper will describe its use in preparing ridership forecasts. Sketch planning is a miniplanning process in which, during a short period of time, a relatively comprehensive analysis, forecasting, and evaluation process is completed for transportation planning without the use of a metropolitan computer model. It depends on availability of a comprehensive range of base data, mapped onto McHarg type of overlays, so that the technical team can take a broad perspective and propose a series of reasonable alignment alternatives. The team computes "indicators" of ridership forecasts, construction costs, and impact evaluations for a wide range of network alternatives in a fairly rapid fashion. The method is particularly useful in a suburban situation where transportation and development corridors are not well defined by historical patterns and a wide range of alignment alternatives is possible. The method allows rapid evaluation of this range of alternatives and reduction to 3 or 4 reasonable alternatives without the time and cost of multiple computer forecasts. Sketch-planning forecasts should not be confused with top-of-the-head "instant plans," which may have received little analysis.

If carefully documented, sketch plans can immediately be submitted for public review and comment and for coding as inputs to the metropolitan transportation planning computer package.

Suburban Forecasting Problems

Data Base—In any transportation study the analyst will usually complain about the age of the home interview survey data. Unless the survey was conducted within the last 2 years, the income, trip rate, trip distribution, and trip length results that are assumed to be consistent over time may have shifted. However, the data become obsolete much faster for the suburban portion of the metropolitan area than for the region as a whole because the most intensive growth occurs in the suburbs. In most suburban areas, the home interview survey data does not include disaggregate survey design or parameters, and key data items are not updated. Residential, commercial, and industrial development may have completely changed the character of many suburban areas and also the types of trips that are generated; in the central city, few major changes may have occurred.

The following approaches to updating the suburban data base for transit planning should be considered (they are not mutually exclusive):

1. Market research sampling of transit and automobile behavior, characteristics of transportation system used, socioeconomic characteristics of trip-makers, attitudes of trip-makers, and advertising media response and forecasting consistency;
2. Annual home interview survey of residents of developing areas, especially a small census-stratified sample survey;
3. Before and after surveys of major service innovations, such as the BART impact surveys;
4. Complete home interview survey that is compatible with a previous outdated metropolitan survey but includes disaggregate sample selection and data;
5. Sample surveys of travelers to major trip generators; and
6. Screen-line counts, vehicle occupancy counts (for preferential treatment), and parking surveys at maximum traffic volume points with revised survey instruments.

Unless the metropolitan home interview survey is recent, no suburban bus improvement needs study should be undertaken that does not include surveys.

Growth Constraints—The rapidly growing areas of the suburbs are also faced with great uncertainty regarding governmental policy on growth and the possible impact of environmental lawsuits on both shore-line and interior growth rates. For example, one water district in a rapidly growing area of Orange County is under court order to limit the water supplied and the connections made for the next 20 years. Thus, the population and travel forecast levels are suspect.

High Socioeconomic Groups—Suburban areas characterized by high income and multiple automobile ownership may be undergoing changing attitudes toward high-quality transit service. These groups can afford to exercise their latent demands for travel and will do so if quality of service is good. Existing forecast models such as the LARTS model show an inverse relation between income and transit use (4, 5). However, surveys taken in suburban areas where significant transit service improvements have been introduced, such as the Skokie Swift in the Chicago area, exhibited a fairly even distribution of transit use propensity throughout the income range (6).

Transportation-Disadvantaged Group Forecasts—A relatively invisible but large number of transit-dependent populations in suburban areas may or may not benefit from transit services that are developed for a majority of high-income travelers who work in the CBD. We need to forecast who will benefit from our proposals. Unless base-year and forecast disadvantaged populations are prepared for each analysis zone, the benefits of the proposals will be difficult to assign to those who will receive them.

Freeway Congestion—A general assumption is that alternative rapid transit proposals will have alternative impacts on freeway congestion in a city area. The impact can be estimated in the transportation study model, but the effects of special freeway bus operations must be added. Both bypass lanes for ramp metering and exclusive bus or exclusive bus and car-pool lanes may have a significant impact on congestion for the remaining cars and affect ridership as was described earlier. Travel models that are not capacity constrained now show 1990 volumes, if no further freeways are built, that would congest a 12-lane freeway on what is now 6 lanes. If this is true, then high-speed transit must be seriously considered.

Significant Service Improvements—The transportation planning forecast models generally produce better results for minimum and expected improvements in service level than they do for radical improvements in transit service, as will be discussed below. Special services that have differing measures of service quality may make the results suspect. New rapid transit lines with short headways have captured as much as 40 percent of all possible trips in the corridor. These values appear to fall at the extremities of mode-choice curves where the regional model is most uncertain.

Three suburban corridors where radical improvements in transit service were made, radical increases in transit's market share occurred, and some useful data were collected were compared (Table 1) to determine whether the data are sufficiently consistent to establish other points on the modal-choice marginal utility curve or whether a different mode-choice model is needed.

Marketing Factor—None of the transportation planning forecasting models takes into account the extensiveness of the marketing and advertising effort that has been invested in a new transit service. This type of evaluation is routinely done in the marketing research field, where marketing expenditures must usually be justified by the extent to which they change peoples' attitudes and choices. Thus, for example, dollars of marketing investment per dollar of operating cost (not per dollar of gross revenue, which is misleading in comparison with unsubsidized private industry) could be considered a system characteristic and might be calibrated like other system characteristics such as frequency of service.

Suburban Mode-Choice Model Verification

As part of the subregional transportation planning work program, the mode-choice model should be able to replicate suburban mode-choice behavior in situations where radical improvements in transit level of service are proposed. There are 2 types of travel behavior or transit market to replicate: suburb to central city (external) and suburb to suburb (internal). Also different methods can be used to verify a mode-choice replication in a suburban area:

1. Obtain data on suburban response to radically improved transit service in other metropolitan areas and apply the data to the marginal utility equation;
2. Use market analysis survey results to calibrate an additional independent variable in the mode-choice equation—either attitudes toward transit, a trip-maker characteristic, or percentage of operating cost for marketing, a system characteristic;
3. Develop a disaggregate, stochastic, behavioral demand model that replicates the suburban life-style;
4. Code a ubiquitous transit system in which a saturation bus system provides service everywhere and transit ridership is never constrained by capacity or level of service (12);
5. Verify the Gumbol distribution calibrated for the Blue Streak service in Seattle (this distribution estimates marginal utility of transit from a policy forecast of business miles per capita, assuming standard fixed-route express service, and has been implemented in Orange County for internal trips);
6. Code a sample sector or subarea of transit improvements and innovations and use suburban transit-calibrated diversion curves to compare travel time and cost impact on diversion by calibration from high-quality suburban transit experience; and
7. Disaggregate total work trips from 1970 census reports or tapes and from home interview survey data, factor out unlikely employers, and factor in population growth.

The verification approach for suburb-to-CBD trips will be analyzed here by method 1. The responses of suburban residents in 3 areas where radically improved suburban commuter service was recently instituted were compared to the Los Angeles Regional Transportation Study (LARTS) mode-choice model parameters and other useful measures of actual ridership (Table 1). For each of the LARTS parameters, the range of transit market share was determined. Market share for transit can be defined as the percentage of total trips between 2 zones and intervening zones that are using the transit mode, or the percentage with a reasonable choice riding transit. The share could be further refined to delete construction workers carrying tools, salesmen using their cars during the day, and those having other occupations that prevent their using transit, but that was not considered here. An arbitrary judgment factor in the definition is the zonal area served, such as circumscribing 95 percent of all existing transit users.

Four types of mode-choice characteristics are compared to normalize the data on 3 suburban response areas in the LARTS calibration. The first, system characteristics, including almost all of the transit system design factors that might affect ridership, are included here and are included in the LARTS model. Values of these model factors are generally within the range of calibration of the LARTS model, but the large percentage of total trips captured by transit sometimes far exceeds the range of market share percentages that have been calibrated as a percentage of total trips. However, market share is a more disaggregate and therefore more consistent statistic than percentage using transit because neighborhoods vary widely in predominant occupation among commuters to the CBD or some other trip-end zone, and some obviously cannot be served by fixed-route transit.

We can then define potential market share with one equation:

$$MS = \frac{\sum\limits_{ij} \sum\limits_{xyz} t_{ij}}{\sum\limits_{ij} t_{ij}} \times 100 \text{ percent}$$

where market share equals the percentage ratio of total trips from zones$_i$ to zones$_j$ for occupations or industries x, y, and z to all trips made from zones$_i$ to zones$_j$; origin zones$_i$ are residential zones within ½ mile of a bus route or within 4 miles of a park-and-ride lot or site; and destination zones$_j$ are employment (peak period), medical, shopping, and so on, trip destinations within ¼ mile (½ mile for park-and-ride) of the bus route. Destination zones$_j$ can be interpreted as the 1970 census CBD, if it is sufficiently compact. Each trip purpose or market segment can be separated, as in census journey-to-work trips to be served by express buses. Fixed routes would serve all trips in their corridor; major transferring trips would be handled separately. Demand-responsive areas would serve all internal trips or all trips from many origins to few destinations. Shuttles would serve internal or screen-line and noncordon trips in a small area. Travel time differences and other system technology variables establish not the potential market share but only a particular system's response and are not part of this equation. The equation is fairly obvious; it is the concept that is not generally understood.

If the transit route serves more than 2 zones$_j$ these can be added in until only, say, 5 percent of transit trips come from outside the group of zones. Occupation or industry data are generally available from home interview survey data or by census tracts, which can usually be aggregated to zones.

For family income, the one socioeconomic characteristic of the trip-makers used in the LARTS model, high-income values in the model equation would predict a low share of total trips in the corridor going by high-speed transit, whereas high-income trips tend to be long trips and are susceptible to express buses and rapid transit.

Among the measures of trip-making behavior, market share appears as 20 percent of all possible corridor trips on the Skokie Swift and as 36.9 percent of all possible trips on the Shirley busway, where only 54.7 percent of all cordon trips are considered a part on the potential market. These figures exceed most of the percentages of trips by transit that might be predicted by the marginal utility model using Skokie and Shirley system characteristics. The 36.9 percent market share of the Shirley busway is particularly impressive in light of the fact that 57 percent of the riders had a car available.

A fourth group of ridership measures, attitudes of trip-makers toward transit, is proposed as a third independent variable affecting mode choice with the automobile and one that is highly competitive not only for a few trips or one corridor but for a large percentage of the trips in the suburban area. If, as in southern California, there is an immediate need for improvement, then programs such as preferential use of express buses on freeways and major streets, local demand-responsive service, car-pooling computer programs and incentives, and subscription bus services may be considered.

Impact Estimation

If high-speed fixed-rail transit service is to be considered for a suburban area, the effects of such investments on concentration of trip-making in corridors should be investigated. Shopping centers and industrial parks could be sites for transit terminals and collection points. Higher densities would be developed in these areas rather than at scattered sites. Such concentration and development may not be appropriate or desired for some suburban areas.

Marketing Plan

Selecting a transportation network plan and forecasting ridership on that network require an assumption about promotion and marketing that is almost never made explicit in planning studies, even if any assumption has been made. Any level of patronage that is forecast shall be achieved with either no advertising or some level of advertising and marketing investment. When any new service or product is introduced, a marketing program is necessary to introduce it to the public, stimulate interest, and sustain ridership growth. This is much more essential to new suburban service development than it is for an existing and fairly well-known transit route in the central city, because the service is often new and because suburban homes have high turnover.

Marketing is a misunderstood term and is generally incorrectly equated with advertising or promotion. It is both, but it is also much more. It is making sure that the product or service that is designed, such as a new transit service, will meet the need and be accepted by the public. Such marketing goals derive from the public's goals. They ensure that the service will be provided where it is needed and not where it is not needed. Marketing ensures that the cost of the transit service—the fare—is acceptable and can be paid in a way that minimizes resistance, such as a monthly pass. Marketing is also promotion, telling the public and the news media what the product is and how to use it, answering the telephone on the first ring, and advertising in the appropriate media for riders. In summary, marketing includes product design, place of availability, price or amount and method of payment, and promotion with advertising and information services.

A design variable in the Skokie Swift program was an investment of 20 percent of gross operating revenues from the project in marketing (Table 1). Either dollar amounts or percentage of gross operating costs is a useful means of bringing the marketing factor into the system design and into the mode-choice model. Patronage results of marketing programs are fairly readily measurable by standardized marketing analysis techniques, such as before and after studies. Such an evaluation program is under way (13).

An important concept in marketing is the term "share of the market." The concept has been used here to determine the total number of trips that could ever be served by the transit service with any reasonableness, as was explained in the forecasting discussion. Any transit ridership forecasts should include explicit consideration of the percentage of operating costs that will be spent on marketing for that route during the next year.

Table 1. Comparison of mode-choice characteristics in corridors where radical service improvements were made.

Mode-Choice Characteristic	Suburb to CBD: Lindenwold (7)	Suburb to CBD: Shirley (7, 8)	Suburb to CBD: Skokie (5, 9)	LARTS: Calibration Range (10, 11)	LARTS: Market Share Calibrated (percent)
System characteristics					
Percentage of gross revenues or operating costs used for marketing	4	na	20		
Transit access time[a] (walk or drive)	na	na	2 miles max.	2 to 18 min	0 to 30
Transit wait time or headways[a], min	10	11 to 18	2½	0 to 16	0 to 19
Automobile terminal time[a]	Lots fill up	Space available	Lots fill up		
Transit running time[a], mph	47	35	46, 5 miles 30, 12 miles	0 to 10 min	0 to 4½
Automobile running time[a], mph	12 to 30	10 to 20	30 to 40	27.7, 1 to 20 miles	2 to 14
Transit fare[a], cents	35 to 75	40 to 80	45	35 + 8/zone	
Parking cost, cents	25		25		
Automobile operating cost[a], dollar/mile	—	—	0.075	0.0476	
Automobile parking cost[a], dollar/day	1.75	Generally free	0.75 to 3.00	46 percent free in CBD	
Off-peak headways, min	10	No service on most	15		
On-time performance, percent	99, 5 min, but labor stoppages	32, 6 min	Good		
Trip-making behavior					
Average trip length, miles	8.5	12.7	15	10.2	20 to 29
Automobile occupancy		1.35 to 1.61	1.35 to 1.61	1.1 to 1.2	
Riders/seat during rush hour	1.4	1.1			
Percentage of riders shifted to transit from automobiles	40	25	14 to 20		
Ridership					
Weekday	41,500	24,300	na		
Peak	8,000	8,000	1,400		
Market share, percent	na	36.9	20		
Park-and-ride, percent	35	8	30		
Feeder bus, percent	9	0	17		
Socioeconomic characteristics of trip-makers and community					
Family income[a], dollars	14,000	16,400	10,000	7,818	0 to 38 and 60
Automobiles owned	1.3	1.5	1.4	1.4	
Second worker, percent		40 female		27.5	
Have car available, percent	37	57 choice	57.6 licensed		
Elderly, percent	na	0.8	na	8.2	
Population per square mile	3,400	3,700	7,000	5,000	
Attitudes of trip-makers					
Reason for using car	No parking space	Bus too expensive			
Priority design feature	Inadequate capacity	Air conditioning			
Priority service variable	Labor stoppages	Reliable and faster			
Attractiveness of mode	Modern	No interior ads			
Comfort	Smooth ride	Assured seat			

[a]From LARTS marginal utility mode-choice model.

CONCLUSIONS

1. A strongly suburban point of view needs to be taken and expressed in metropolitan transportation planning programs in order to develop advocacy for improved transit service in the suburbs. Most central city or regional transit operators are preoccupied with what appears to them to be overwhelming problems in the central city, where they must try to maintain financial solvency on a daily basis.

2. Urban transit forecasting models in use today are criticized by others for a number of simplifications and artificialities. However, they are even more uncertain in the suburban areas where growth and change are rapid and response to high-quality transit service cannot always be based on low income. Suburban transit studies will generally produce patronage forecasts with dubious reliability unless primary data collection surveys of some type are undertaken. The patronage forecasting effort should include consideration of comparable improvements in other suburban areas and the ridership response that occurred in those cases.

An important innovative design element of patronage forecasting is estimation of the level of expenditure on marketing transit services. Applying market analysis techniques can help to measure the patronage impact.

3. Data are now available to indicate that certain transportation technologies are particularly adapted to the suburban environments. Research presented at various demand-responsive transportation conferences indicates that this mode of operation can provide an attractive, suburban-responsive, low-density-area service that can become almost as efficient as a short-headway, fixed-route service at those densities.

RECOMMENDATIONS

1. Further detailed comparison of suburban-only ridership response to significantly improved quality of transit service is needed for 2 markets: from suburbs to central city CBD and within suburban areas. A number of case studies and demonstrations have been conducted and should be systematically evaluated by the use of additional approaches.

2. Further analysis of the similarities between market forecasting and transportation planning model forecasting approaches should be made so that each may benefit from the strengths of the other.

3. Further field testing of alternative demand-responsive operations is recommended where low densities and high-income populations discourage the development of efficient fixed-route bus services to determine under what conditions its costs are comparable to fixed-route service.

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