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Segmentation Analysis of Transit Users and Nonusers

Douglas P. Blankenship, Orange County Transit District, Santa Ana, California

In a survey to evaluate factors that influence the use of public and personal transportation modes in the Orange County Transit District, a stratified random sample of households was used to ensure accurate spatial representation. A total of 1800 in-home, personal interviews were conducted between June 28 and July 21, 1974. This sample size allowed analysis of subgroup differences at a high level of statistical reliability.

ATTITUDES

Various techniques, including market segmentation analysis, were used to ascertain the attitudinal framework, which plays a key role in the use of transportation by Orange County Transit District residents.

AUTOMOBILE VERSUS BUS ATTRIBUTES

Thirteen characteristics of car and bus travel were rated on a seven-point scale. A multidimensional scaling analysis of these data revealed the following facts:

1. In terms of simplicity of use and convenience, automobile travel outranks bus travel.
2. The most positive rating given the automobile was for its simplicity of use.
3. Bus travel is perceived to be safer, more relaxing, and less expensive than automobile travel. The largest differential between the two transportation modes, among the 12 characteristics measured, was expense.
4. Buses are perceived as being slow during rush hour, but the automobile was even slower.

In summary, Orange County residents seem to have a fairly open attitude toward bus travel and feel most negatively toward the automobile in terms of its expense.

Thus, any media content in a marketing strategy must positively emphasize the positive and neutral aspects of bus travel to influence public acceptance of public transportation.

DEMOGRAPHIC, PSYCHOGRAPHIC, AND LIFE CYCLE PROFILES

The survey identifies various demographic and psychographic profiles that may impact current, future, private, and public transportation modes. Following are some of the key findings about attitudes toward the automobile and traffic in general:

1. Younger age groups with more education and higher incomes, in professional, technical, and managerial occupations, are less inclined to believe that freeways and automobiles must remain the dominant transportation mode in Orange County.
2. Persons who are in the lowest income group are currently transit captive, use the Orange County Transit District bus at least once a week, are 18 to 24 years of age, or are school commuters and are most likely to agree with the statement that traffic today is almost unbearable.
3. The youngest age group (18 to 24) tends to be more transit receptive than other age groups.

Orange County Transit receptivity by the younger age group suggests that the district's marketing program should make specific appeals to this age group to increase ridership. These younger and less affluent persons have not developed reliance on private transportation modes and thus appear to be more receptive to the use of public transport.

Responses to statements that identify groups most willing to try new things suggest that the following characteristics are associated with innovativeness: perceived leadership ability, desire to try new things, age 44 years and younger, post graduate status, annual income of \$15,000 or over, political independence, slight disagreement to adjustment to public transportation, and neither physical nor psychological automobile captiveness.

Although these subgroups may not now be transit de-

pendent, they will certainly be important from a marketing standpoint in providing the Orange County Transit District with a broad base of public support for future transit programs. Appeals to these subgroups must thus be part of the district's overall marketing strategy.

SOCIAL CLASS AND STATUS ANALYSIS

When three statements assessing the relationships between social status and transportation use were asked in this survey, respondents least concerned about the social status of riding a bus were found to be those who do not mind riding with the type of people who ride buses, make \$10,000 or less per year, are middle-aged, do not anticipate a major adjustment in using public transit at present, currently use public transit, consider themselves transit dependent, and feel comfortable talking to strangers.

This and other public transportation studies show that travel and access time factors are major deterrents to public transportation use. Among people most time-conscious are those who (a) would consider riding a bus, (b) drive an automobile to work 3 or 4 days a week, (c) moderately agree that it would be a major adjustment to use public transportation, (d) are 18 to 24 years of age, and (e) are from professional and technical households.

One positive aspect of the Orange County Transit District marketing approach to time would be to show that time can be saved by riding the bus (or other public transportation modes, such as dial-a-ride) and by pursuing other productive activities while en route. Studies show that perceived travel time decreases appreciably as meaningful activities increase.

FUNDING PUBLIC TRANSIT

Two-thirds of the sample believed that federal funds should be used to some degree to subsidize public transportation in Orange County. Half agreed that users should pay most of the cost, and slightly less than half disagreed with that position. Clearly the majority of respondents believe that public financing should make some contribution to public transportation.

FROM PSYCHOLOGICAL AUTOMOBILE CAPTIVITY TO TRANSIT DEPENDENCY

Responses to questions assessing perceptions of access to various transportation modes and actual or psychological bondage to a particular mode produced several key findings.

1. Ten percent of all commuters believe they could easily use public transit for work and 11 percent would find such use only slightly inconvenient.
2. Many of those who use the automobile out of habit would be more receptive than average to a public transit alternative.
3. Other Orange County Transit District studies agree with this one on the percentage of persons using both automobile and public transit.
4. Only about 1 percent is unable to use public transportation because of physical disability, and accommodation of this group with such devices as elevator lifts and wheelchair restraints should be considered by the Orange County Transit District.
5. Those in lower income groups are more likely to be transit dependent than those in higher income groups.
6. The younger age groups are more receptive to public transit and more likely to use a car because of habit than because of perceived necessity.

7. Females are less likely to be automobile dependent and more receptive to public transportation than males.

8. Habitual car users include 22 percent who said that it would currently be impossible to commute by bus and 52 percent who could easily commute by bus.

9. Automobile users habitually drive the fewest kilometers per week; this suggests that psychological captivity decreases and real captivity increases as distance to work increases.

10. As the number of home-based trips per day increases, habitual automobile use increases.

11. Those who live and work in Orange County are more habit-bound to the car (59 percent) than those who live in Orange County but work in Los Angeles County (20 percent).

12. The greater the current use of the Orange County Transit District bus is, the less automobile-dependent the resident will be.

Full use of this survey information in an effective marketing program can segment the market and persuade many habitual automobile users to switch to public transit.

VEHICLE AVAILABILITY AND TRIP MARKET PROFILES

Unrestricted private transportation almost universally characterizes the people of Orange County as evidenced by a number of findings. In Orange County, 94 percent of the adults have drivers' licenses; 80 percent of the households have two or more frequent drivers; 97 percent of all households have one automobile, and 75 percent have two or more automobiles; and nearly 90 percent of the adults have a car available when needed.

Orange County residents enjoy perhaps unmatched car mobility, but endure congestion, pollution, and high-energy, intensive mode problems; therefore, public transit becomes an important alternative to consider.

The findings on high car mobility showed that (a) the more drivers per household there are, the greater the mobility of household members will be, as evidenced by trips per person per day (only 6 percent of one-driver households, but 18 percent of four-driver households, make four trips per day), and that (b) 14 percent of Orange County adults travel more than 563 km (350 miles) per week, or 80 km (50 miles) or more per day.

Major findings on commuter trip patterns indicated that

1. Of all commuters, 73 percent remain in Orange County, 23 percent drive to Los Angeles, and 4 percent work elsewhere;
2. The areas with the most commuters are, in descending order, Anaheim, South Bay, central Los Angeles, and Southeast Los Angeles County;
3. Nearly 50 percent of Buena Park's commuters, 25 percent of those in Garden Grove, and 7 percent of those in Santa Ana travel to Los Angeles County;
4. Of those who earn less than \$7,000 per year, 93 percent work in Orange County, but of those who earn \$25,000 or more, 61 percent work in Orange County and 33 percent in Los Angeles County; and
5. More than twice as many males (29 percent) as females (12 percent) commute to Los Angeles.

The survey showed that 70 percent of automobile commuters drive along 5 days or more each week, 16 percent drive 40 min or longer one way, fewer than 4 percent pay for any parking, more men (22 percent) than women (12 percent) are likely to work different hours, and more women (30 percent) than men (15 per-

cent) take care of personal business on the way home from work.

An active marketing program should increase the number of bus commuters. One transit-receptive group is lower income commuters who work in Orange County. Since women are more transit receptive than men, use the Orange County Transit District bus twice as often as men, and for noncommuting trips are much more likely to car pool than men, district persuasion to encourage use of rapid transit should give men priority. The Orange County Transit District marketing program, then, should be vitally concerned with the total modal mix and make the best use of private and public transportation modes in the county.

CONCEPTUAL AWARENESS AND ANTICIPATED USE

Orange County residents are fairly well aware of fixed-route and scheduled buses. Over two-thirds know of their neighborhood bus service. There is no difference in awareness of local service by sex or automobile availability, but the lower a resident's income is, the more aware he or she will be.

Three key elements for any bus system are fare, distance from the bus stop, and frequency of service. Among responses to unaided recall questions on these three factors, we found that

1. Respondents are more familiar with distance to the bus stop than with fare or service frequency (nearly 60 percent perceive the bus stop to be within three blocks of their residence);
2. A fare of 25 cents is generally given as the local, one-way fare, and nearly 50 percent of the respondents could indicate a cost; and
3. Only about 40 percent of those aware of bus service knew its frequency, and 75 percent of those indicated a frequency less than hourly.

The perceived closeness of local bus service indicates that the Orange County Transit District has done a reasonably good job of route planning. The Orange County Transit District might also persuade more residents of Orange County to commute by bus, since those working in Orange County are more aware of neighborhood bus service than those who commute to Los Angeles.

Several conditional choice combinations of cost, distance, and bus frequency were presented to respondents. When respondents were asked how many times out of 10 they would ride the bus for each scenario presented, we found that (a) at a 15-min interval and a fare of 25 to 35 cents, there is little difference between use at distances of one to three blocks, but use drops from 60 to 40 percent at a five-block distance; (b) 30-min interval use is uniformly lower at three to five blocks than at one block, regardless of cost; and (c) at the 60-min interval (fare of 25 to 35 cents), use at the one- and three-block distance is similar, but this drops markedly at the five-block distance. Thus, frequency and distance play an important part in predicting use and are also important in the convenience mix considered by potential transit users. Cost is also important, since anticipated use drops when the fare is 50 cents or more, regardless of bus stop distance or bus frequency. Alterations in current district fare policy are not the issue here, but the fare of 25 to 35 cents does seem to be the most palatable to respondents.

DIAL-A-RIDE

To assist planning, implementing, and expanding the innovative dial-a-ride system, we assessed the awareness

of and interest in the system and reasons for its use. Awareness of dial-a-ride was high, given its limited operation within the county. More than 60 percent of the respondents were aware of the concept.

Although awareness levels for conventional buses were higher for lower income groups, awareness of dial-a-ride was higher for higher income groups. Males and middle-aged persons were more likely to be aware of the concept than females or the youngest or oldest age groups. Anticipated use of dial-a-ride by city ranged from 80 to 35 percent; 7 percent of the respondents indicated anticipated use of dial-a-ride 5 days or more per week, 12 percent indicated 3 or 4 days, and 25 percent indicated 1 or 2 days.

Shopping (71 percent), recreation (47 percent), work (23 percent), church (23 percent), and school (10 percent) were the primary uses anticipated for dial-a-ride. Women would be more likely to use it for shopping, men for recreation or entertainment.

ANTICIPATED DEMAND FOR PUBLIC RAPID TRANSIT

Respondents were asked about their anticipated use of a public rapid transit system with a 130-km/h (80-mph) speed; 10-min service; one-way fare of 50 cents; distance from home or destination of 5, 10, 20, or 30 blocks, and door-to-door feeder. Men rather than women, those with higher incomes, and those who work in Los Angeles County are more likely to use such a system. It appears that a balanced modal mix of automobile, bus, dial-a-ride, and public rapid transit system can all serve specific submarkets within Orange County.

MARKETING AND ADVERTISING PUBLIC TRANSPORTATION

The findings of this survey can be used by the Orange County Transit District to assess the impact of its advertising in creating positive attitudes toward public transportation, making key target groups aware of Orange County Transit District services, and increasing the use of public transit in Orange County.

Any advertising program must be concerned with at least four items: level of public awareness, the media, content recall, and positive or negative impact of the message on the target groups.

ADVERTISING AWARENESS AND MEDIA ANALYSIS

Over two-thirds of respondents recalled Orange County Transit District advertising; most aware were men, the young, and those with highest incomes. Awareness of direct-mail advertising was greater for women but was similar for all income groups except the highest, for which it was lower. Men and the young are more aware of billboard advertising than women or the old, older age groups are more aware of newspaper advertising than those in the youngest age group, and men and the younger age groups are more aware of radio advertising than women or the older age groups.

Based on these survey findings, the following are recommended:

1. Since current nonusers (men and those with high incomes) are most likely to be aware of advertising, a change in emphasis in the marketing program is suggested to reach these subgroups.
2. Direct-mail advertising should continue because of its importance in influencing women to use public transit.

MESSAGE CONTENT AND IMPACT OF ADVERTISING BY SELECTED MEDIA

The best recalled advertisements concern fares, routes, schedules, increased service, convenience, and conservation of petroleum resources, and those advertisements about convenience, service, and schedules have greater influence than other messages on persons switching to public transportation.

The high level of awareness of Orange County Transit District advertising (69 percent) indicates an effective advertising program, and making even more people aware of services should increase use. Women may be more influenced than men by advertising because they are more receptive to alternative transportation modes or a perceived level of captivity for certain periods of the day.

The effectiveness of direct-mail advertising in supplying schedule and route information suggests that more intensive study is needed to maximize the potential of this kind of advertising, which appears to be the single most effective medium for increasing bus ridership, especially among women. However, the Orange County Transit District should maintain a media mix to reach all target groups and, especially, maintain the personal and specific elements that increase receptivity to the message.

CONCLUSIONS

This report highlights the findings of a base-line study to assist the Orange County Transit District in marketing public transportation now and in the future. A second survey is planned to permit longitudinal and trend surface analysis. A more detailed analysis of the data is warranted by the comprehensiveness of the study, but various departments within the Orange County Transit District will be assisted by this report in serving public mobility needs.

Citizen Opinions on Public Transportation Roles, Service, and Financing

David L. Weiss, Planning and Research Bureau, New York State Department of Transportation

This report summarizes the results of a recent statewide public opinion survey conducted in 1000 households across New York State. Topics addressed include opinions on public transit performance, transit needs, public participation, transit users, automobile-oriented policies, and funding sources and financing. Results of the survey indicated that (a) New York State residents think that regular dependable local bus service is the most important transit need, (b) transit is used most frequently by middle-income (rather than low-income) groups, and (c) there is strong support for special services or lower fares for the elderly and handicapped.

During the summer of 1974, a series of public hearings was held by the New York State Department of Transportation to air public views on transit. The information gathered at these meetings was useful in obtaining information quickly for studies on transit operating assistance being done at this time. Those conducting the hearings, however, recognized that the full spectrum of public opinion was not represented. Accordingly, the department contracted Market Facts, Inc., to conduct a statewide public survey on a wide range of transit problems and related issues, such as community transportation problems, operator performance, importance of different factors influencing travel mode choice, and public preferences for different transportation-assistance programs. This paper summarizes the findings of the survey. Complete findings are available elsewhere (1).

DATA

The survey consisted of a sample of 1000 households selected randomly throughout New York State. The sample was divided equally among four geographic areas: New York City, other major metropolitan areas with over 50 000 population, small urban areas with between 5000 and 50 000 population, and rural areas.

Figure 1 shows the distribution of interviews. Respondents were chosen to represent the demographics of the state. Samples of certain groups were weighted, since the process of selection, because of time or budgetary constraints, could not exactly match the state's demographic profile. The survey was conducted by personal interview, and the refusal rate was negligible.

The replies were broken down into the following categories of the state's population: geographical residence, family size, family income, age, sex, race, automobile ownership, and mode to work. From these breakdowns, it was possible to analyze reasons for responses and obtain profiles of users of various modes.

CHARACTERISTICS OF TRANSIT USERS

An understanding of public feeling toward transit depends on a perception of the demography of transit users and nonusers. The survey revealed some surprising facts on this subject. Transit is not used most by those families with the lowest incomes but by those earning from \$3000 to \$9000 and above \$25 000 per year:

Family Income (\$)	Avg Days per Week Used	Family Income (\$)	Avg Days per Week Used
<3000	1.55	12 000 to 14 999	1.05
3000 to 5999	2.07	15 000 to 24 999	1.28
6000 to 8999	2.08	>25 000	1.78
9000 to 11 999	1.54		

Those families with incomes between \$6000 and \$9000 are the most frequent transit users because their incomes do not permit the daily operation or necessary maintenance of an automobile; yet their employment and higher disposable income (as compared with those earning less) generate a number of trips.

Those who annually earn below \$3000 are mostly retired persons, among whom physical disability, the absence of employment, and a small disposable income lower trip-making potential. Among them, however, automobile ownership is surprisingly high; 46 percent

reported having at least one car, only 5 percent less than those in the \$6000 to \$90000 income bracket. It is likely that the retirees, having bought their cars when they were working, retain them until maintenance and operational costs or physical disability force them to give their cars up. The high degree of transit use among those earning \$25 000 or more is less explainable. A large percentage of this group may live in the New York City area, where they use the rail commuter network. Any conclusions, however, about the behavior of this group must be regarded as tentative because the sample taken of them was small.

Transit use in New York State is a function of city size, and, therefore, the service available in the urban area: The larger the area is, the more transit will be used. The largest group of everyday riders (42 percent) live in New York City, and, among the city's total population, transit is used an average of 3 days/week. By contrast, the largest group of persons who never use transit (84.2 percent) live in rural areas. More than half the population from other parts of the state say they never use transit (54.3 percent in major metropolitan areas and 65.6 percent in small urban areas).

MODE FOR WORK AND NONWORK TRIPS

The mode to work is the automobile (Table 1), except in New York City, where three-fourths of all work trips are made by transit.

Most nonwork trips in New York State are by automobile. The smaller the population is of the area in which a person lives, the greater the chance is that he or she will use the automobile as passenger or driver for nonwork trips. Even in New York City, almost half of the nonwork trips are by automobile (Table 1). Twice as many New York City residents use bus as use rail probably because of the nature of the city's transit system. The rail system radiating from the central business district serves Manhattan with its concentration of unexcelled cultural activities. However, use of these facilities by the city resident is expensive and relatively infrequent, and the opportunity for taking advantage of them by transit is decreased at night when infrequent rail and subway scheduling, fear of crime, and less traffic congestion encourage automobile use.

The bus system, on the other hand, functions as a connector to the rail lines, providing services to areas where leisure activities are concentrated. Except for a few rush-hour express services, almost no buses connect Manhattan with the outer boroughs, but they do provide services to outlying shopping districts.

Generally, however, the higher a person's income is the more frequently automobiles will be used for nonwork trips. Even among the lowest income group automobile use is high, primarily because of the high rate of ownership among the elderly, who constitute the majority of this group. The only exception to the correlation between income and automobile use is among those in the \$6000 to \$9000 group, which is transit oriented.

REASONS FOR HAVING TRANSIT

New Yorkers view transit as a supplemental rather than a primary means of transportation. Of the reasons given for having transit in New York State, 6.1 percent of the respondents indicated keeping downtown strong; 15.1 percent, reducing air pollution and saving energy; 18.7 percent, reducing traffic congestion; and 59.9 percent, providing transportation to people without cars.

The view of transit as supplemental is more prevalent where transit service is less comprehensive. The smaller the area is and the less extensive transit service is, the more passive its role will seem to people.

PUBLIC PERCEPTION OF TRANSIT PROBLEMS

Twelve percent of all New Yorkers rank transportation as the most serious societal problem; in contrast, 40 percent rank crime as the most serious, and 15 percent rank drug use as most serious. Bus services are considered to be the major problem in all parts of New York State, even in New York City, where bus services are the most extensive and frequent (Table 1). In New York City, severe traffic congestion, which slows operations; the necessity, until now, of paying a full fare for transfers; and the need to use buses to reach rapid transit are being influenced by these considerations. Interestingly, the need for door-to-door bus service seems to be one of the major needs in the city.

Elsewhere in the state, the infrequency and the lack of cross-town service and the sparse coverage of many systems are considered to be the reasons for the feelings about the need for improvement of bus service. Rural residents feel this need more than others. Many New York City residents think that rapid transit service requires improvement (Table 2). Although extensive, the system requires major rehabilitation as well as significant additions to its physical plant. Overcrowding, lack of direct service to major activity centers, and long, slow rides are commonplace.

SUBSIDIES FOR THE DISADVANTAGED

Generally, there is strong sentiment among all New Yorkers to provide some special transportation service or lower fares for disadvantaged groups. Support for such aid is strongest for the handicapped and the elderly; school-age children and low-income groups, in that order, have the least support (Table 2). However, in all cases, two-thirds of all New Yorkers support the subsidy. Even among the highest income groups, normally the most conservative, sentiment for such aid is strong. Analysis of replies on basis of respondents' modes to work shows automobile users least inclined for any reduced-fare program. Transit users have the same strong opinion favoring aid to all groups; however, aid for the poor is supported less strongly among this group.

AUTOMOBILE-ORIENTED POLICIES

When given a choice, 34 percent of all New Yorkers would rather not penalize the automobile for the benefit of transit (Table 1). If the automobile were to be restricted, however, the prevalent choice is to ban them from downtown areas. New York City residents more strongly favor downtown automobile restrictions than any other limitation. Their next choice is not to make the automobile more costly, but more respondents in other areas favored this policy, most likely because New York City is least dependent on the automobile. In contrast, only 15.5 percent of the rural residents are in favor of restricting areas that automobiles may enter. The feelings about not restricting automobiles are stronger in other parts of the state than in New York City, but not so strong as the feelings in the rural areas.

Table 2. Percentage of survey respondents according to their attitude toward lower fares or special transportation services for the disadvantaged.

Attitude	Group			
	School-Age	Elderly	Handicapped	Low-Income
Strongly opposed	2.3	1.5	1.4	4.2
Somewhat opposed	4.1	2.2	2.4	7.4
Neutral	7.4	2.9	2.8	15.2
Somewhat in favor	23.4	14.1	12.4	20.8
Strongly in favor	62.7	79.3	81.0	52.5
Mean ^a	1.40	1.67	1.69	1.10

^a0 = neutral; -2 = strongly opposed; +2 = strongly in favor.

SUMMARY AND CONCLUSIONS

1. Transit is used most frequently, not by the low-income but by the middle-income groups. Low-income groups do not have disposable income to participate in activities that would entail transit use.

2. Transportation is considered to be the most serious problem by 12 percent of the state population. That feeling is more prevalent in rural areas than in New York City. In fact, most rural residents (21 percent) consider transportation to be the most serious problem. Most people, particularly rural residents, see transit as filling a transportation gap—providing transportation to those without cars.

3. Approximately one-third of the population considers some aspect of local bus service to be the most serious transportation problem. Frequency, lack of dependability, and lack of service (particularly in rural areas) are the most frequent complaints.

4. Most people feel that regular bus service is the greatest transportation need in New York State. This opinion is especially prevalent in the urban areas, except in New York City where door-to-door bus and additional rapid transit are considered to be the greatest needs.

5. There is strong support for special services or lower fares for the elderly and handicapped. Support for subsidies for school-age children or low-income groups, although still constituting a majority, is somewhat weaker.

6. About one-third of the population would rather not see the automobile penalized for the benefit of transit.

The survey has reviewed feelings of New York State residents on a number of transit issues. The results are instructive, and the data are invaluable in drafting legislation and opening several possibilities to further citizen participation programs. Public feelings have been given more consideration and, as a result, the transportation planning process has been sensitized to public need.

REFERENCE

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Starting the Transit Industry on a Search for Affluent Markets

Richard R. Reed, Social Engineering Technology, Los Angeles
Kenneth R. Ingram, Division of Mass Transportation, California Department of Transportation

This paper describes the logic behind the design of a state-level government program to assist the transit industry in the adoption of marketing practices. Marketing is seen as essential, given the awkward standing of transit in the travel market and the tentative nature of its political support. In marketing, the diffusion of innovation model postulates that the industry will accept marketing practices in a series of stages. Each stage, while growing less experimental, will draw new adherents who need increasing certainty and tend to address issues not resolved in the earlier stages. The opportunity for government is to manage this process by creating the material and environment that stimulate the maximum participation of those in transportation who are able to move in each stage. The emerging California Department of Transportation program, tailored to the existing stage of early adopter behavior, is to highlight the concept of market segmentation and its corollary strategy of offering specialized services at different fares to distinct affluent groups identified by market research.

Public transportation has only recently become an area of concern for state government in California. The present agency group concerned with state transportation, the Division of Mass Transportation (DMT), came into existence in 1973 with the creation of the California Department of Transportation. DMT, like similar agencies in other states, is to be a knowledgeable advocate for public transportation within state government and a source of management assistance for the operators of local transit properties.

Because marketing is an emerging field within public transportation, DMT created a marketing branch and set about to devise the most effective program for California in this area. Marketing was given prime emphasis by the division because of its unique capability of influencing the population's support of public transportation both as potential transit users and as voters.

We authors, one as an independent consultant, had primary responsibility to design the DMT marketing program. This paper reports on this work and presents the policy conclusions that have since been implemented in state activities. To our knowledge, this is one of the

few cases in which a government program in transportation has been shaped by the principles of social design to induce change in the practices of its industry. The focus of this paper is on the marketing of marketing to the public transportation industry in California, specifically the promotion of the orientation to market segments in transit.

PRESENT CIRCUMSTANCE OF TRANSIT

This is clearly a unique time for transit. Not since the "early booming days of the street railway business" (1) has expansion in peacetime been expected for the industry. This public support has spawned the expanded funding for transit development and equipment. It also creates the environment for a needed shift of the industry toward a marketing orientation.

Awkward Market Position

Transit is one of the few industries still producing a standardized product for its entire market. Normal economic practice is that a market is broken into segments with different needs and abilities to pay. The providers of food, clothing, and other basic needs assume that consumers desire products with varied style, quality, and price; however, providers of buses do not.

This is an important realization because most people do not purchase the standard transit service any more. The comprehensive transportation studies of the 1960s throughout the country showed that 95 percent of the people who have the choice to take their car take their car, and now there is one car for every two people in urban areas.

The result in California is that public transit carries a low percentage of the travel in its market. The regional surveys show the transit share of person trips to be 5.9 percent in the San Francisco Bay Area, 2.2 percent in the Los Angeles metropolitan area, 2.5 percent in the Sacramento region, and 1 percent or less for the remaining 48 public transit operators in the state. (A narrower focus on the center-city counties of these regions would raise these percentages but, in most cases, not double them. For example, as estimated by the

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California DOT publication, DMT Trans Guide, Los Angeles County would have 4.5 percent; Sacramento County, 3.5 percent.)

The typical Californian simply never uses transit. This was confirmed in a 1277-household survey conducted in the Sacramento metropolitan area in April 1975. The survey, designed by DMT in cooperation with the Sacramento Regional Area Planning Commission and the Sacramento Regional Transit District, is especially reliable because of the ability to cross-relate the data with a survey conducted in May 1974. Eighty-five percent of the households surveyed reported that their members never use transit; only 9 percent had a member who used transit frequently and that member was as likely to be the offspring of the household as it was its head (2). Incidentally, similar results have been found in a national study. A representative survey of Americans made in 1970 found that 82 percent of the males in the survey never used a bus for travel. Among those who had bus service available, 75 percent of the females and 87 percent of the males chose to use their car every day, and only 6 percent of the females and 5 percent of the males used a bus every day. Of those who used a car every day, only 1 percent also used a bus every day (3).

In effect, transit serves a market segment, but it is exactly the worst segment from a marketing perspective. In California, as is the case across the United States, choice riders have been a distinct minority. Few people with car keys in their pocket seem willing to hitchhike on a system primarily intended for the disadvantaged. Outside of the commuting periods, 85 to 95 percent of the riders on a bus are there because they have to be there. Many have low incomes; they have exhibited their inability to pay the full price of the service. Therefore, revenues never meet costs, and the industry is always faced with the need for outside funds.

Ridership, of course, will be affected by marketing practices. The experience in California over the last year was that public transportation increased ridership 23 percent through the use of promotion and improvement of the standard bus service. But the danger is that transit can learn to advertise, adopt modern graphics, establish new staffs for information and point of purchase sales, and become technical about consumer surveys and still have to sell its product below cost to a limited population and rely on funding from a car-owning majority that is often personally indifferent to transit's fate.

Tentative Political Support

There are those who argue that a useful service at low (or no) fare can survive because the public realizes the benefits from a reduction in energy use, road congestion, and pollution. It is true that current support for transit results from widespread disaffection with these consequences of the automobile. A 1974 survey in Los Angeles County, for example, reports that 73.5 and 79.7 percent of the respondents feel smog reduction and rush-hour traffic relief, respectively, are good reasons to support rapid transit (4). Of the respondents in the 1975 Sacramento survey, 75 agreed with the statement, "The Regional Transit bus system makes this community a better place to live" (2).

However, the surveys also show that this support for transit is based on beliefs not firmly held. On the traditional attitude scale of one to five, strong agreement to strong disagreement, with three indicating neither agree nor disagree, the median response was 2.58 to the statement, The use of buses for public transit improves the air quality in the Sacramento area. The

opposing statement, Buses help make smog conditions worse in the Sacramento area, earned a 3.34 median response. Although 65 percent of the respondents agreed with the statement, The Regional Transit service ought to be considered a public service like libraries, schools, and parks, none of the proposed financing methods got a ranking of satisfactory except for fare increases to match service improvements. Increases in property taxes ranked last (2).

Presumably, the public will begin to gain accurate information on the impact that transit's growth has had on their communities' experience with pollution and traffic congestion. When those data are produced, they will probably show that a transit ridership equaling 2 to 6 percent of an area's travel has relatively little impact on pollution, particularly when so many transit riders do not drive anyway. Simultaneously, those most concerned with the ecology will have reduced their own guilt feelings by switching to smaller cars with expensive emission controls. And the everyday effect on rush-hour traffic from incremental increases in support for transit is difficult to perceive. In fact, the median ranking from the Sacramento survey on the statement, Buses create traffic congestion on downtown streets, was just barely on the disagreement side of neutral at 3.33 (2).

Increasingly, the philosophic reasons for support of transit in the abstract will return to the concept of welfare for those who do not drive; we think that that is not reason enough. (Even the energy issue seems most easily translated in the public's mind to concern over the ability of low-income people to travel, given no interruption or control over gas consumption.) This is a matter of constituencies. Transit, or any government agency, cannot prosper if its primary benefits flow only to the disadvantaged. This is evident when we examine the continuing situation of the other welfare agencies, the poverty program, public clinics, and the rest. Transit itself experienced the same bitter dynamics during the periods of the 1950s and early 1960s and could again experience them.

Thus the key to the future course of public transportation is the production, in view of both the economic and political markets, of real benefit for the majority, those who rely routinely on their automobile for travel.

IMPORTANCE OF MARKET SEGMENTATION CONCEPT

One of the appeals in the marketing orientation to transit is the possibility of altering the circumstance of the industry both financially and politically. A number of specialists raised the importance and policy consequences of industry adoption of the marketing practices so prevalent elsewhere in the economy. We think that the most significant lesson to be gained by public transportation from its experience with marketing is the concept of market segmentation.

Market segmentation is the process of designing (or featuring) a product or service that will make a particularly strong appeal to some identifiable subpart of the potential market. The process is as much a strategy of exclusion as it is a focusing on particular customers because a specialized offering (or campaign) tailored to a particular group will tend to reduce its appeal to other groups. In that sense, market segmentation is a set theory problem: how to delineate the characteristics that will define a group of consumers that can be profitably served, given their differing abilities to pay and the cost functions of production, distribution, and promotion.

Such calculations of the economy are now typical. At the early stages of all industries, the efficiencies in producing a standardized product for the public market

ruled. It was not surprising that Henry Ford was reported to have said, "Give the customers any color they want, so long as it is black." But most producers of consumer goods began to shift toward a practice of differentiation between market segments.

The process is described as follows (5):

Marketing managers have always had to cope with the heterogeneity of buyers. As society becomes increasingly affluent, as discretionary income allows this heterogeneity to be more fully expressed, the problem of determining useful typologies of consumption patterns has attained paramount importance for marketers.

The result of the process was commented on by Smerk (6): "No well-managed firm will produce a product or service for which there is no demand, regardless of how well and efficiently it can be produced."

Public transportation is the last major industry to attempt promotion of a standardized offering to its entire potential market. That is, as marketing has begun to have influence on the industry, most properties have chosen to emphasize their characteristics as a system, promoting and standardizing, with new graphics, the ubiquity of the standard bus service offered at a uniform exact-change fare. The strategy has not been particularly successful. In California, at least, the net effect has been to increase the requirement for operating subsidies for increased peak-hour volumes at reduced below-cost fares.

Thus, it is likely that marketing people becoming familiar with transit will suggest opportunities for specialized services for particular market segments not now drawn to transit. The marketing profession is oriented to differentiating segments, and there are a number of industries in which a shift to a segmentation strategy enabled a firm to recover from a poor market position.

The cafeteria and motion picture industries, for example, both lost their primary businesses and were left with residual markets with no profit potential. In fact, their residual business was much like transit: People had no private alternatives (kitchens or televisions) and were unable to pay their share of the costs of the business when volume was reduced. Both also suffered from the peaking phenomenon that is so expensive in transit operation. These industries decided that their only course was to reattract the mainstream markets. Although still providing a low-cost product needed by the disadvantaged, they introduced new quality products that could earn a premium price (7).

We think that transit can and should follow the same course. Public transportation has the responsibility to serve the disadvantaged and others not able to travel by automobile. But, given the economic and political requirements, the industry should recognize that its useful low-fare service serves only one of the market segments that can be attracted to transit. Most important, new market segments need not be constrained by the present uniform fare. Most Californians live in a world where \$0.25 to \$0.35 will just buy a cup of coffee. A quarter is almost throwaway money and is certainly no reason to go out of our way for an unattractive service. But a fare of \$0.75 to \$2.00 might well be charged for a high-quality service. Such fares and the increased clientele would, of course, change the whole economic structure of the industry. Already, California transit properties are offering specialized or premium-price services.

There are other examples in the private sphere, such as the club bus, airporter service, and vans dedicated to shuttle service for particular firms. Transit people, and indeed most innovators in marketing, tend to think

of these specialized offerings as exceptions to the rule. In fact, they are the possible future for public transportation.

Specialized services have not yet taken full benefit of the potential for premium pricing through a tailored appeal to an affluent segment. We think that such a change will only be accepted by the industry if it is the consequence of a marketing orientation. The politics of transit support have been debated for so long that no one can now argue for a new transit role based on policy. But an opportunity to create new markets might be heard and tested, and this could lead to industry experience with larger revenues and a more extensive political base. It is this result that makes marketing and market segmentation so important.

DIFFUSION OF INNOVATION MODEL

Everyone does not accept even a good idea at the same rate. There is a process involved, much like the process we see when a new product is introduced and gradually penetrates its market. Mainstream people will wait to endorse the marketing concept in transit, as they waited to accept the Volkswagen Beetle, until the idea has first been tried by adventurous trendy people and then until it has been further tried by people like themselves. It must be clear that the adopted pattern is consistent with their aspirations and identities.

Today, Volkswagen owners identify themselves in surveys as more conventional than their neighbors and as less willing to try new products that have not yet been proved. Someday, the transit industry could view marketing as a routine, conventional part of their business. The result will come about in steps, and government can best assist if its efforts are matched to the appropriate stage in the diffusion of the new idea.

Sociologists have constructed a model of how change spreads in society. The diffusion of innovation model categorizes the people adopting a new idea or product into groups displaying different motivations and needs (Figure 1). As related to the marketing concept for transit, these are: innovators, early adopters, general acceptors, and the mainstream.

Innovators

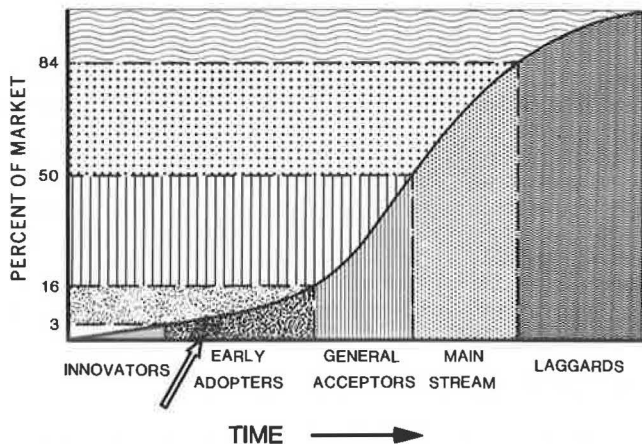
Innovators are the first to experiment with a new idea: those who imported the first Volkswagens, built their own waterbeds, and first raised marketing in a transit context. Innovators are few, but members tend to know of each other's activities as indications of what is new. The fun for innovators is experiencing the new idea (the new product), directly seeking the changes it makes in their lives, and receiving recognition as a pioneer. When the innovation begins to become predictable, innovators move on to new territories.

Innovators must be either affluent or otherwise independent of peer pressure so that they can take risks in trying new things. Most of us cannot experiment with products or ideas that might jeopardize our work status and income. Thus it is not surprising to note that the innovators of the marketing concept in transit have by and large been academics, people whose livelihood is outside the industry. But their capability of raising ideas as trial balloons encourages the entry of the next group.

Early Adopters

Early adopters take an emerging idea and integrate it into their life-styles and perceptions. Most of the people now concerned with marketing in transit are early

Figure 1. Diffusion of innovation model.



adopters. The fun of being an early adopter is in dealing with an idea (or product) that has been tested by the innovators. There is a much lower risk in being associated with the new thing, but a full sense of being identified with what is new and exciting. Early adopters are essential to the process, however, because they display how an idea or product fits with an established life-style. Early adopters pay attention to removing contradictions brought about by a new idea and are more likely to investigate how transit marketing can be integrated with operational patterns and the realities of customer attitudes. This work is essential because it establishes a basis for the next group.

General Acceptors

General acceptors also think of themselves as progressives, but they have the task of fitting a new idea into what is probably a more rigid life-style and less tolerant environment. They take their cues from presentations in the media that show that a new product or idea is worthy, understandable, and nonthreatening. For example, the appearance of commercial camper sites along most major highways permitted acceptance of recreational vehicles by the general acceptors. When the transit industry begins to request marketing specialists in the management structure of a transit property, one can expect that the concept of marketing outlined by early adopters is being considered by general acceptors, whose roles are to carry an idea into the established structure.

The Mainstream

At some point, the new idea or product has been accepted by the majority as typical practice. The diffusion of innovation model describes yet later groups, late adopters, or laggards. These groups tend to feel they cannot afford the social, political, or economic cost of experimenting with nontraditional concepts, so they wait, heavily bound in their commitments by institutional traditions. Their existence is the reason some organizations maintain the status quo in spite of changes taking place in other similar organizations.

Stages of Acceptance

The sequence in the diffusion of innovation has been most elaborated by persons concerned with the marketing of new products. Research, for example, has been done on the rate at which credit cards, color phones, or

the push-button dial have been adopted in the community. Application of the model to the emergence of marketing in transit does stretch the point somewhat. This is even more true because the marketing concept is fully developed in other sectors of the economy.

Because marketing is so prevalent an idea, most people think they know what marketing would mean in the context of transit. The only valid role for innovators is to mention marketing and transit in the same conversation and then quickly make it known that the small change in the more traditional practice of transit management will soon be enlarged by early adopters invading the transit field with the new perspective.

The early adopter stage will similarly be shortened simply because all of us are so familiar with advertising, pricing strategies, market research, and the development of new offerings as they are used with other products. Early adopters will be responsible for adjusting an already established technique to transit rather than for working from an initial concept.

Nevertheless, the diffusion of innovation model tells us that transit will adopt marketing practices only through a process involving stages of acceptance. Each stage will have a distinct flavor and a unique group of enthusiasts. The overall pattern will be that more conventional groups will replace the experimental as, in turn, the controversies that restrict still wider acceptance are resolved. And the resolutions in each stage will not be challenged in the next.

Thus we can expect that public transportation will first debate and test the concept of marketing, then its techniques, then how marketing specialists should be included in a transit organization, and finally how marketing practices can be performed routinely. Only if the industry reaches the right decisions at each of these stages will the marketing concept make its full contribution to transit.

OBJECTIVES FOR GOVERNMENT ACTIVITY

In the transit industry, marketing is now being accepted at the early adopter level. People are attracted to the marketing concept because it is new and exciting. It is a subject defined as appropriate for a person dissatisfied with the status quo. But we have not yet agreed about what marketing means in a transit context. Some speakers use the word marketing to justify expansion of the planning function, others hope promotion and consumer education will build ridership served by existing lines, and others argue that a marketing orientation should lead to the creation of new services from a profit-seeking viewpoint.

These differences in objectives and understandings are characteristic of the early adopter stage. This is the time when the industry tries out the new idea, adopts it to the circumstance of transit properties, and reexpresses the marketing concept in transit language. If this work were not done, marketing could not be accepted by more conventional people in the industry. Marketing would remain an idea for the future whose relevance was not seen in day-to-day practice.

But the early adopter stage is limited in time. At some point the people first drawn to an emerging idea finish their work and move on to another area of exploration. The idea has been discussed and debated until the subject becomes boring, worn out, and abandoned. In transportation planning, for example, the early adopters have long ago left the subjects of modal-split models and citizen participation. These matters are now being used by the more conventional groups in the diffusion process. This means that this work is carried out routinely and

with less imagination and that we cannot go back to challenge the now-established assumptions in these subjects. For better or worse, the results of the work performed when the subjects were first introduced must now be the basis for all further work in that area.

This is why we think the movement of California DOT toward segmentation will be most encouraged if early adopters of a marketing viewpoint in transit also accept the following key ideas:

1. The marketing concept includes the creation of new services tailored to the needs of different market segments.
2. Each service will have different characteristics and different prices. Vehicles, scheduling, interior configuration, and fare levels are some of the variables to be determined from market research.
3. The only potential growth market for transit is among the mainstream affluent persons who already own cars. Transit planning for the captive rider is only one segment, but this is vital to the community welfare.

If the transportation industry does not confront the possibilities for premium-fare services aimed at the affluent car-owning market segments in the early adopter stage of marketing concept acceptance, it never will. The industry's disposition is to accept the role of a subsidized provider of useful service to the disadvantaged. When current campaigns to sell that service to the affluent fail, as they must without quality improvement, the industry will be stranded again, but, if we are skillful in managing the process, we may be able to avoid this. There are specific things government can do to encourage adoption of a full marketing ideology in transportation.

CALIFORNIA TRANSIT MARKETING PROGRAM

To ensure that these ideas become generally accepted, the DMT program is shaped to support those people in transportation who are already introducing marketing practices. The expected pattern is that DMT activities will encourage early adopters to endorse marketing, and stimulate them to apply marketing techniques, particularly those suggesting market segmentation, to the transit context and to produce instruction manuals, standard procedures, demonstration projects, and training sessions to consolidate work already performed. The purpose of this latter activity, of course, is to prepare for the transfer of proved techniques to the next group and thus release innovating personnel to more experimental endeavors. The leading example recently has been the consolidation of work done on telephone information centers; the Urban Mass Transportation Administration is now performing a similar function in sponsoring a transit marketing management handbook (8).

There are three current directions in transportation: creating images of the possibilities for transit, assembling the materials that early adopters can use on their respective jobs, and generating decision-making tools built about the strategy of market segmentation.

Thus, DMT, often with regional transportation planning agencies and universities, is designing and arranging workshops that highlight marketing viewpoints. These provide a platform for innovators in the field and help convince early adopters that the transit business can concern more than the production of kilogram-kilometers. In an aligned effort, DMT is assembling printed examples and slides of different types of service and their characteristics including price. Transit-like services provided by private parties (e.g., commute clubs) are par-

ticularly useful as illustrations.

A game teaching transit use has also been developed for public school systems, and the basic format is transferable to the varied cities of the state. Deliberate introduction into popular media of the concept of quality service for premium fare is also being explored to stimulate consumer support. Such a campaign would emphasize both simple price differences and innovative ideas of new buses.

With regard to segmentation, DMT has assembled demographic data that suggest patronage opportunities among market segmentations in many of the urban areas of the state. The information displays categories of income, trip purpose, life-style adherence, and life-cycle placement. The information is available in a California DOT publication, DMT Trans Guide, which is distributed to all transit properties and related agencies in the state, includes various types of marketing information, and is periodically updated.

Most recently, DMT, the Sacramento Regional Transit District, local California DOT district personnel, and consultants under contract developed and managed an attitudinal and on-board survey project. The method was based on the use of similarity (preference) mapping of market segments developed by market research specialists. The survey has already yielded useful policy information, although much of the cross tabulation and analysis is not yet complete.

The questionnaire forms and their coding, computer programs, and cross tabulation methodology were designed to be applicable to most urban areas of the state. Thus, DMT is documenting the procedures for publishing in a marketing instruction manual and is duplicating the software for use by other agencies. It is expected that the tool will serve both as model and training instrument for transit operators and as a basis on which operators and transportation planning agencies can derive transit market plans that emphasize segmentation strategies.

Thus, the California program is designed to match the existing stage of marketing acceptance. Different activities will be required at different times; the division feels that market segmentation should be primarily emphasized now because it is the key to the recovery of an industry so long beset by financial difficulties. A secure recovery will aid the cause of balanced transportation.

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Demonstration of Potential for Improved User-Oriented Transit to Major Trip Generator

Edward Beimborn, Joseph Kampschroer, James Marsho, and John Weiss,
Center for Urban Transportation Studies, University of
Wisconsin—Milwaukee

Momentum is growing throughout the United States to revitalize and restructure public transit systems serving urban and rural areas. Many transit systems face a bright future of new equipment and expanded services where only a few years ago they were near collapse. The function of transit used to be defined as providing service within the constraints of fare box revenues; it now includes providing service to meet the mobility needs of large segments of the population. Transit is seen in many places as a way to reduce congestion and air pollution, save energy, provide mobility for those without an automobile, and increase the vitality of the central city and the livability of suburban and rural areas.

To meet these goals requires new concepts for transit systems that provide attractive, user-oriented service that can effectively compete with the automobile. One area in which there is a potential of high payoff from transit improvement is improved access to major trip generators, such as an industrial area, airport, medical center, or university that provides a large concentration of trip-making activity around which specialized transit service can be centralized. Specialized transit services to major trip generators can be tailored to a particular need and provide a level of service much higher than would be found with conventional service, which can compete more effectively with the automobile. A further advantage is that specialized transit can be more easily marketed than conventional service because the service can be aimed at a particular group. Specialized services, however, will tend to cost more than a conventional service, and the impact of the specialized service on the base levels of conventional service may be of concern. If the specialized service, rather than the automobile, diverts a large portion of its riders away from the conventional service, the financial workability of both the regular and specialized services may be threatened. This paper will document the results of a

demonstration project, the UBUS, which provided a direct user-oriented service to a major trip generator, the campus of the University of Wisconsin—Milwaukee (UWM).

The UWM campus is located in Milwaukee County on the east side of the city of Milwaukee approximately 4.8 km (3 miles) north of the Milwaukee central business district. The total enrollment is about 25 000, most of whom are commuters, and there are 4000 members of the faculty and staff. This gives the university a total population of nearly 30 000 persons and makes it the second largest generator of trips in southeastern Wisconsin next to the Milwaukee CBD. Because of the small size of the campus, 34 hm² (85 acres), only 1900 parking spaces can be provided on campus for the 10 000 automobiles that are driven to the campus each day; as a result, over 8000 automobiles must be parked on the surrounding streets. Thus, the UWM campus has all the characteristics of a major trip generator: a lot of trip-making activity, congested local streets, and severe limits on parking supply.

PROJECT DESCRIPTION

The demonstration project provided modified urban bus service direct to a major trip generator along a set of bus routes serving a large portion of the Milwaukee metropolitan area and included inducements to potential riders, such as direct, no-transfer service; convenient schedules; minimum travel times; reduced fares; easily accessible off-street parking; convenient route locations; and a homogeneous rider group. During the course of the project, a series of alterations were made in these routes to determine the effects of these changes on the users. Two general types of services were provided: integrated services, in which existing local bus routes were extended to the campus, and exclusive services, in which new special routes were developed and operated for the use of only university students, faculty, and staff. In addition to these, the routes differed in the provision of park-and-ride facilities, partial or full express service, and hours of operation and the general routing patterns.

During the fall 1974 semester, four routes (Capitol Drive as an integrated route and Silver Spring Drive,

Oklahoma Avenue, and North Avenue as exclusive routes) were operated and a \$0.25 fare was charged. For the spring 1975 semester, the fare was increased to \$0.35, evening service was added on two of the routes, and a special express service (the Oklahoma Streaker) was added from the end of Oklahoma Avenue to the campus. Later the North Avenue route, which had previously operated as an exclusive route, was dropped, and two new integrated routes that involved the extension of existing bus routes to the campus began operations (North Avenue and Burleigh Street integrated routes). Table 1 gives the features of each of the seven routes of the demonstration project operated from September 1974 to May 1975. The project concerned three major categories: the operation of the service, marketing efforts connected with the service, and technical studies associated with the service. The service was operated by the Milwaukee Suburban Transport Corporation, the local private transit operator. Further details on the project are available elsewhere (1).

PROJECT OBJECTIVES

The overall goal of the UBUS project was to evaluate the effectiveness of high-quality, user-oriented transit service (UBUS) to a major trip generator (the campus of the UWM). User-oriented transit can be defined as transit service developed to meet the particular transit needs of a select segment of travelers. Such service should provide a direct link between the user's origin and destination at times convenient to the user and at a cost to the user that is competitive with that of the automobile. The aims of the project were to determine to what degree such a service could attract new riders away from their automobiles and at the same time minimize the adverse effects on existing transit service. The specific project objectives were

1. To reduce the number of urban vehicles,
2. To reduce the urban highway and parking facility requirements in the UWM area,
3. To attract enough students, faculty, and staff from areas of concentration to make these routes worthy of integration into the regular bus service so that general public transit service could be facilitated,
4. To provide an efficient and reliable transit service as an alternative to the private automobile and to improve the overall campus-community environment by easing local traffic and parking congestion, and
5. To develop procedures for future demonstration projects and service experiments.

In effect, the success of the UBUS program largely depended on the sources of its ridership. If the users of the service included many people who otherwise might have driven a private automobile rather than

those who would normally use transit, the program would successfully meet its objectives. If the reverse was true, the objectives would not be met. Thus the UBUS service had to be oriented to the needs of its users.

PROJECT RESULTS

To determine how well the UBUS project met its objectives, a series of technical studies were undertaken. These studies included on-board surveys of UBUS users, overall travel surveys of all persons traveling to the university, and analyses of parking and community impact. Only limited results of these studies are given here; more detailed results are available elsewhere (1).

Ridership

The average daily ridership on the four UBUS routes was 4382 one-way trips per day during the fall semester and 4079 one-way trips per day on the five routes in the spring semester. During the 31 weeks of UBUS operation, 644 288 trips were estimated to have been made on UBUS routes. This daily ridership rate on the UBUS was higher than that on 19 of the 21 urban transit systems in Wisconsin and was only exceeded by that on the systems in Milwaukee and Madison. The 40 percent fare increase (from \$0.25 to \$0.35), which occurred at the beginning of the spring semester, did not appear to have a major impact on ridership. Ridership appeared to fluctuate with student enrollment, and a large number of people tried out the service for a short time early in each semester.

Origins of UBUS Users

UBUS drew its ridership from a variety of points in the Milwaukee metropolitan area. These origins differed from those of the UWM population as a whole. Although large concentrations of students were found in the immediate vicinity of UWM, these people generally walked, bicycled, or hitchhiked to campus. With the exception of the Oklahoma Avenue exclusive route, the special Oklahoma Streaker express service, and, to some extent, the Silver Spring Drive exclusive route, each of the routes drew riders from those areas immediately adjacent to [not more than 0.6 km (1 mile) from] their right-of-way. The Oklahoma Avenue, the Oklahoma Streaker, and the Silver Spring Drive exclusive routes drew riders from wider geographic areas. In the case of the Oklahoma routes, this was due to their relative separation from the other four routes by Milwaukee's industrial valley. The larger draw of both the Oklahoma and Silver Spring routes was also due to their locations on the southern and northern boundaries of the UBUS system, which ran east and west.

Table 1. Characteristics of UBUS routes.

Characteristic	Oklahoma Avenue	Oklahoma Streaker	Silver Spring Drive	North Avenue	Capitol Drive	North Integrated	Burleigh Street
Exclusive use	x	x	x	x			
Integrated service					x	x	x
Park-and-ride	x	x	x				
Partial express	x			x			
Full express		x					
Fare change	x		x	x	x		
Evening service	x		x				
Routing change						x	
Added service		x					x
No transfer service	x	x	x	x	x	x	x

Changes in Mode Choice

Major shifts have occurred in the mode of access to UWM since the advent of the UBUS program. Automobile access to the university has dropped from 70.1 percent to 61.0 percent of all trips. This decrease in automobile use has been matched by an increase of total bus use from 12.3 to 21.3 percent. Thus, automobile use has dropped by about one-seventh, and transit use has nearly doubled; about 1700 persons have switched from automobile use to transit use since the advent of the UBUS program.

One of the key questions for the UBUS project concerned diversion: To what extent does the UBUS attract persons away from the regular city bus lines? The diversion rate, defined as the percentage of riders who would use the regular bus if the UBUS were not available, obtained from the various surveys conducted was 41.3 percent. There was a considerable variation in the diversion rate on the different routes. Those routes that were extensions of regular bus routes had the highest rates of diversion, and outlying routes where transit service to the university by regular bus was difficult had lower diversion rates. The diversion rate on the Oklahoma Streaker express service was the lowest of all the routes surveyed. This route was highly competitive with the automobile on a travel time basis, and its riders were nearly all drawn from areas with little or no bus service.

The UBUS on-board survey asked for student opinions on general transportation characteristics. Effective operations and low cost were the transportation characteristics that were most important to UWM students. Those items that stressed convenience for commuters, such as not having to transfer, and direct home-to-destination operations, ranked in the middle of important characteristics. Only the club bus factor, riding with similar people, was not very important to the student respondents.

Parking Use

Major changes in parking supply and use occurred in the UWM area since UBUS service began. Total parking supply has increased from 7959 spaces to 8866 spaces (11.3 percent); all of the increase occurred in off-street spaces. Total use has dropped from 6855 to 6357 spaces (7.2 percent) during the same period. On-street use dropped by 923 spaces (17.8 percent), and off-street use increased by 425 spaces (20 percent). Of the total decrease in on-street use, most occurred since the beginning of UBUS service in September 1973, and most was recorded during the period of September 1973 to September 1974. The balance of the decrease occurred during the 6-month period from September 1974 to February 1975. A portion of this second decrease can probably be attributed to the addition of off-street parking facilities.

As a result of these changes in supply and use, the availability of parking spaces in the UWM area has increased substantially. In the fall of 1972, before UBUS operations began, a net difference between supply and use of 1104 spaces existed. This difference increased by 80 percent to 1985 spaces by fall of 1974 when UBUS operation was under way and by 127 percent (compared with the fall of 1972) to 2509 spaces in the spring of 1975. Nearly all of this increase has occurred in improved availability of on-street parking spaces. This increase in available parking supply has occurred in spite of an enrollment increase at UWM of over 10 percent in the same period.

CONCLUSIONS

From the preceding information, we concluded that the UBUS successfully met its objectives of reducing urban vehicle travel, reducing urban highway and parking facility requirements, and attracting enough users to make the routes worthy of integration into the regular urban area bus service. It appears that there is a great potential for specialized, user-oriented transit service to major trip generators. Such service can be closely tailored to user needs and carefully marketed to reach its target groups. Accordingly, the following recommendations were made to the project sponsors:

1. The potential of major trip generator-oriented service should be explored in other cities. Such service has a great potential for attracting large numbers of persons away from their automobiles and into transit vehicles. Identification of major trip generators, analysis of travel patterns to the generators, analysis of the adequacy of the present transit service to the generators, and development of a transit service closely related to the needs of the travelers to the generators should be undertaken by each transit operator in conjunction with relevant state and regional planning agencies.
2. An extensive marketing program should be used whenever a new venture in public transit is undertaken and should include identification of potential users and segments of the market; design of a service package to meet user needs; effective communication of information about the service to its users that emphasizes service attributes that the users think are important; and continuing efforts to identify new market segments, monitor the success of the program, and modify it on the basis of feedback from its users.
3. Efforts should be made to operate parking and transit services that complement and enhance each other.
4. Careful technical studies should be undertaken to assist local transit agencies in developing their transit services.
5. Demonstration programs are more useful when appropriate before-and-after analyses are undertaken and the results are disseminated.

ACKNOWLEDGMENTS

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Analysis of Suburban Shopper Market for Public Transit: A Case Study

Daniel R. Aerni, City-County Planning Board, Great Falls, Montana
Vasant H. Surti, Center for Urban Transportation Studies, Denver

During the early 1970s, there was a significant resurgence in the urban public transit industry. This resurgence was due in part to a fundamental change of approach by transit operating agencies in regard to the marketing of their services. Where public transit was once regarded as a standard, utilitarian service provided to a general public, it is now seen as a commodity to be sold by using techniques originally developed in the highly competitive consumer marketplace. These have been used to improve the market appeal of the transit service and to actually sell this service to potential users.

So far, the marketing efforts of many transit agencies have tended to stress nonservice improvements: promotion, pricing, and public relations aspects of marketing. Public relations training for drivers, progressive slogans, advertising campaigns, and promotions have been used extensively. Such nonservice improvements have proved to be relatively inexpensive and have succeeded to a degree in improving the image of public transit and in attracting public transit patronage.

In marketing, a product or service that is clearly inferior to another has only limited market potential. In many cases, a product or service must be improved before marketing techniques can be of any real value in boosting sales. This is the general situation of the transit industry today. In most cities, the level of service provided by public transit is inferior to that provided by the private automobile. Until the service provided more accurately reflects what the public wants and needs, promotion and public relations campaigns are limited in effectiveness. Service improvements must necessarily precede or, at the very least, run concurrently with nonservice efforts.

TRANSIT MARKETING FOR SHOPPERS

Traditionally, the major emphasis of urban transit has been on the home-work trip, concentrated during two relatively short peak periods of the day. This is understandable since more urban trips are made for the purpose of travel to and from work than for any other single purpose. Initial improvements in transit service have generally been made in the area of new or expanded express routes primarily serving workers during peak hours.

Yet the shopping trip market should not be ignored. Slightly more than one of every five trips in the Denver metropolitan area are made for shopping (1). Even though shopping trips are somewhat more dispersed than work trips, both in time and spatial distributions, the number of these trips alone suggests that marketing efforts might be applied successfully to increase transit ridership. Furthermore, the shopper population provides a well-defined and specialized market, to which specific marketing techniques could be applied. It is also possible that specialized transit service for shoppers could be operated during off-peak hours, when transit facilities are not used to capacity.

DEFINITION OF PROBLEM

In Denver, the percentage of work trips via transit is more than three times that of shopping trips made by transit (1). Among other things, this reflects the emphasis given the home-work trip by the transit authority. One might be inclined to say that the home-work trip is better suited for transit use. For the Denver central business district, however, the percentage of shoppers who use transit is comparable to and in fact exceeds the percentage of workers who use transit (2).

The question explored in this research is: How can marketing techniques be applied to urban public transit to influence shoppers to use transit? Two aspects of this question have been explored: Is it feasible to institute local shopper-oriented transit service, to major shopping centers or districts, comparable to that provided for CBDs? and, What special features should be

incorporated into the service as a means of attracting shoppers to public transit?

DELIMITATIONS

The Denver, Colorado, metropolitan area was used for the research. Only regional shopping centers were considered for transit service. Neighborhood and community shopping centers and districts were excluded, since shopping for convenience items, particularly groceries, accounts for a large portion of the total shopping activity that takes place at these areas. In the regional shopping centers, the shopping activity is predominantly for comparison items for which public transit is more suitable (3).

DATA COLLECTION AND ANALYSIS

A list was drawn up of all regional shopping centers in the Denver metropolitan area. Selected physical and socioeconomic characteristics of each shopping center and its nearby market area were assembled and compared. This analysis revealed a general trend for smaller, older shopping centers to be located in regions of higher population density closer to the CBD. As it was hypothesized that a significant difference in trip characteristics exists between older and newer centers, the decision was made to study one shopping center from each category. Villa Italia Shopping Center in Lakewood, Colorado, was selected as a representative of the larger, newer group of centers in an area of low population density. Lakeside Shopping Center in Wheat Ridge, Colorado, was selected to represent the smaller, older centers closer to the CBD.

The service envisioned in this study was a collection of bus routes focusing on the suburban shopping center as a collection-distribution point and extending out in short one-way loop routes into the neighboring communities. With such a system, the immediate surrounding community would have convenient access to the shopping center via transit. Frequent bus stops in the residential area were visualized as a means of shortening walking distances for users. At the other end of the trip, special boarding facilities close to the shopping area would eliminate the long walk from parking lot to stores.

The principal method of data collection was an attitude survey, conducted by telephone, to determine the potential market for transit service in the vicinity of each center. Results from this survey were first tested statistically against 1970 census and more recent demographic data, then calibrated by means of data obtained through two other methods: counts of traffic and individuals at each shopping center and a personal interview survey to determine the origins of the center's patrons.

These data were assembled and analyzed to yield information concerning the suburban shopper's needs and preferences and to determine the feasibility of instituting transit service in the vicinity of each shopping center. A computer model was used to analyze the effects on transit patronage of four parameters: headway, travel time, fare, and number of blocks walk to the bus stop. A number of routes were then subjectively drawn up for each center. Ridership and revenues for each route were projected from the data collected, costs were projected from data obtained from the Denver Regional Transportation District, and the economic viability of each route was evaluated. Optimal operating parameters (fare and headway) were determined for each system of routes.

For evaluation purposes, the subsidy per passenger was used. If the subsidy per passenger for a route or system of routes was less than or equal to the current 1974 Denver Regional Transportation District subsidy per passenger of \$0.2182, the route was considered to be feasible. A route for which the subsidy per passenger exceeded the 1974 value but did not exceed the projected 1975 subsidy per passenger of \$0.48 was considered to be marginally feasible. A route for which the subsidy per passenger exceeded the projected 1975 subsidy per passenger was considered to be unfeasible (4).

On completion of the feasibility analysis, a user preference study was undertaken to determine the primary factors influencing the modal preference of shoppers and to point out features that could be incorporated into the shopper service to attract shoppers to it. For this part of the research, an attitude survey was administered to persons living within easy access (one block or less) to three existing bus routes providing good service to the CBD.

RESULTS

Traffic Counts and Shopper Origin Studies

The distribution of trips to analysis zones in the immediate vicinity [3.2-km (2-mile) radius] of each shopping center was determined by the traffic counts and shopper origin studies. The smaller shopping center, Lakeside, which attracted a smaller total volume of shoppers, attracted considerably more shoppers from areas near the shopping center. The patronage of the larger center, Villa Italia, was found to be much more widely dispersed than that of the smaller center. Of importance also is the fact that a considerable amount of shopping is done at both shopping centers during the evening peak hours. Therefore, operation of any shopper bus service throughout the evening peak period seems necessary if continuity of service is to be provided. Little travel to either shopping center is done during the morning peak period.

Attitude Survey and Benefit-Cost Analysis

On the basis of costs and revenues projected from the attitude survey results, the feasibility of each proposed route was determined. Of the 20 routes examined, 4 proved to be feasible, 3 marginally feasible, and 13 unfeasible. It is significant to note that only one of the proposed routes in the Villa Italia Shopping Center vicinity met even the marginally feasible criterion. Similarly, the proposed routes in the Lakeside Shopping Center vicinity that failed both feasibility criteria were all located on the side of the shopping center away from the CBD, in communities with suburbanlike sprawling development. The routes judged to be feasible were all located on the older, more densely developed side of the shopping center closer to the CBD. Overall, the route system in the Lakeside Shopping Center vicinity met the feasibility criteria; the route system for the Villa Italia Shopping Center did not.

User Preference Study

From the results of the user preference study, it would appear that where excellent bus service is offered to the CBD, the bus claims a good share of the market for shopping trips. Four major reasons explain why the bus is preferred by so many:

1. Difficulty of parking and driving downtown;
2. Low cost of travel by bus;
3. Convenience of the bus and perceived overall shorter travel time by bus between the areas surveyed and downtown; and
4. Strong trend of individual dependence on transit, due in part to the low car ownership in the areas surveyed.

The first reason is by far predominant, indicating that the popularity of the bus is not of its own making but in actuality should be attributed to the private automobile's inconvenience for shopping trips to the CBD. Presumably, transit ridership would not receive the same stimulus where suburban shopping centers are concerned.

The reasons for use of the private automobile are much more diverse. It appears significant that four of the five reasons most often mentioned relate to the inconvenience of the bus:

1. Difficulty of carrying packages on the bus,
2. Long travel time by bus,
3. Inconvenience of the bus for trips where multiple stops are made, and
4. Having to wait for buses.

This suggests several features that could be incorporated into transit services designed specifically for shoppers:

1. Facilities on buses for carrying packages. Possibly, racks could be installed near front and rear doors of buses and sturdy shopping bags carrying the logo of the transit system could be sold by means of vending machines at boarding locations in shopping centers or could also be given away on special promotional days.
2. Facilities to make waiting for the bus more pleasant. Attractive, comfortable bus shelters would fulfill this need as much as is possible. This is desirable at selected spots along the route and particularly at the shopping centers.
3. System permitting users of the shopper service to make stops along the route and reboard another bus without charge. This would make it easier for shoppers to make combined trips via transit.

The survey results also suggest that a concerted effort will be required to make the potential users aware of any new service. Publicity for new shopper service appears to be needed on an ongoing basis and in the period following initiation of a new route.

CONCLUSION AND RECOMMENDATIONS

Feasibility of Shopper Service

The results of the study indicate that local shopper-oriented transit service is generally feasible for the older regional shopping centers of a metropolitan area, located in areas of medium to high population density. For all other shopping centers, including the newer regional centers in low-density suburbs and neighborhood and community shopping centers throughout the metropolitan area, such service appears to be unfeasible at the present time.

A combination of circumstances are seen as contributing to the applicability of transit service to the older regional centers:

1. Patronage of the older shopping centers is drawn from a fairly compact area in the vicinity of the center.
2. Major shopping activity at these shopping centers is shopping for comparison goods rather than for convenience goods such as groceries.
3. On the average, households in neighborhoods near the older shopping centers own fewer cars than households in the newer low-density, automobile-oriented suburbs and have a lower average household income and a greater proportion of elderly residents.
4. Most neighborhoods in the vicinity of the older shopping centers are currently served by conventional transit routes and have been for some time. Residents of these areas, consequently, are more accustomed to using transit and more willing to use it.
5. Street patterns in neighborhoods near the older shopping centers are generally more amenable to transit use than those in newer suburban neighborhoods where cul-de-sacs and curvilinear streets are the rule rather than the exception.

Special Features of Shopper-Oriented Service

There is no reason why transit service that will be used primarily by shoppers needs to be identical to service catering primarily to home-to-work commuters. Therefore, the study has identified a number of features of a shopper-oriented transit service that potential users judged to be desirable:

1. Fare of \$0.15 to \$0.25 for local shopping center service;
2. Bus within one block of the user's home, if possible, and two blocks at most;
3. Difference in travel time between the bus and the private automobile of no more than 15 min;
4. Facilities for the convenient carrying of packages on buses, e.g., racks at the doors of buses or distribution of shopping bags to bus users;
5. Facilities to make waiting for the bus more pleasant, e.g., comfortable shelter facilities at shopping centers; and
6. Transfer system that would make it convenient for a shopper using the bus to make multiple stops.

Other operational details for the shopper service that are desirable from the passenger standpoint include

1. Scheduling that is uncomplicated and easily remembered. Buses departing on the hour, or a similar clock-based schedule, would seem to be the most acceptable means of accomplishing this.
2. Easily recognized route designations. In a situation with multiple routes converging on one location this is essential. Color coding of buses with matching colors at boarding areas and on schedules and other printed materials would adequately fill this need.
3. Clearly designated boarding areas for each particular route at the shopping center. These designated areas would make it easy for passengers to find and board the desired bus.

DISCUSSION OF STUDY METHODS

Through all that has been determined in this study, the following question remains: Can the attitude survey results be accepted as accurate? The present situation involves a unique type of service proposed for many people who have not had adequate transit service for years. There is really no method of judging

short of actual trial service. Transit demand forecasting, like any other type of forecasting, is subject to many unknown and unpredictable influences that can only be fully evaluated in actual operation.

It was felt that the open-ended question format used in the attitude survey, asking the respondent to specify his or her own tolerance limits for service levels, was a suitable means of minimizing biased responses and of determining an individual's potential use of transit. This format avoided reliance on point blank questions such as, Would you use the transit service? The results generated by the analysis, yielding a spectrum of travel demand curves for different areas, lend support to the belief that the responses were reasonably valid.

Another question could be raised regarding the evaluative criteria used in the present study. The transit routes proposed were evaluated solely on the basis of the projected amount of subsidy per passenger. It was felt that the use of this criterion takes into account the patronage of the route and also its cost-effectiveness. The new routes were not required to balance expenses with farebox revenues to meet the feasibility test but were expected to perform at a level equal to that currently met by the transit system as a whole. Whether other criteria should be included in feasibility analyses of new transit routes is not within the scope of this study. Other criteria, such as reduction of traffic congestion, reduction of air pollution, provision of transportation for the disadvantaged, or conformance with adopted community transportation planning objectives, could be included in a benefit-cost analysis. Use of such criteria would almost certainly enhance the feasibility of the shopper routes.

The market research analysis conducted in this study is undoubtedly time-consuming and therefore costly. But public transit planning for suburban areas must rely on up-to-date survey work, as Benson affirms (3): "Unless the metropolitan home-interview survey is recent, no suburban bus improvement needs study should be undertaken that does not include surveys." If metropolitan area residents want public transit service that is geared to their wants and needs, then the time and expense of extensive market research will be required.

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Characteristics and Attitudes of Dial-a-Bus and Park-and-Ride Users in New York State

Carol A. Keck and Gerald S. Cohen, Planning and Research Bureau, New York State Department of Transportation

This comparison of characteristics and attitudes of users of dial-a-bus and park-and-ride services is based on the results of two on-board surveys conducted in New York State. Survey results show that the two systems have distinctly different ridership use levels but that users of both the park-and-ride and dial-a-bus systems were generally satisfied with the service provided. Preferred service characteristics, user satisfaction with existing system characteristics, and written comments on the questionnaires are used to examine the riders' attitudes. Information is also presented on the riders' demographic characteristics, sensitivity to fare and gasoline price changes, and rates of use.

During 1973, the New York State Department of Transportation undertook a comprehensive study of the public transportation needs, system, and potential in Binghamton (Broome County), New York. As part of the Broome County Transit Study, user surveys of innovative transit services (dial-a-bus and park-and-ride) were required. The objectives of these surveys were to determine the characteristics of the market for such services and the attractiveness of service attributes to different user groups so that the demand for such services in the Broome County area could be estimated (1, 2).

The dial-a-bus service in Batavia, New York, and one of several park-and-ride routes in the Rochester, New York, area were selected to provide this user data. In general, the surveys showed that (a) demographic characteristics of dial-a-bus users in Batavia and park-and-ride users in Henrietta were not the same; (b) users of both services were generally pleased with the service, but thought improvements were needed; (c) park-and-ride users were far more sensitive to fare changes than dial-a-bus users; (d) riders on both systems were not very sensitive to changes in the price of gas or the possible introduction of gas rationing; (e) both systems relied heavily on regular users who made use of special subscription rates; and (f) individuals generally used park-and-ride more frequently than they used the dial-

a-bus service, but the reverse is true on the basis of total population. A complete report on these surveys is available from the New York State DOT (6).

ON-BOARD SURVEYS

On both the dial-a-bus and park-and-ride systems, only riders over 16 years of age were surveyed. There were a considerable number (30 percent of the total ridership) of riders under the age of 16 on the dial-a-bus system, but very few on the park-and-ride system.

All riders over the age of 16 were surveyed on the dial-a-bus system; however, only the riders on selected buses with high ridership levels were surveyed on the park-and-ride system.

RESULTS

User Characteristics

Batavia Dial-a-Bus

The dial-a-bus ridership consists mainly of women, and there is little difference among age categories. It might be expected that the major purpose for the use of the system would be among those more typically ascribed to women, e.g., shopping and social-recreational; however, some 75 percent of the total riders (73 percent of the women) use the B-Line service on a regular basis, either for work or school. Conclusions based on this percentage should not ignore the high proportion (53.4 percent) of females among the Batavia population.

The riders who use the B-Line service most frequently are men, in particular, those between 25 and 54. On the basis of the total population, however, the data indicate that women between the ages of 16 and 24 use the service most often and that women generally use the service at a higher rate than men (Table 1).

Henrietta Park-and-Ride

The majority of people who use park-and-ride are women, and there is a high percentage of younger women. Of the 264 questionnaires returned, only 8 indicated that the

purpose of the trip was other than work or school. This is not surprising if one considers that these park-and-ride services are designed to serve peak hours, as are most such services. The park-and-ride route does not serve shoppers well since there is little or no service during off-peak hours. The riders who use park-and-ride most frequently are women in the 25 to 54 age bracket; not only do more women than men use the service, but they generally use it more often than the men.

Table 1 indicates that, on a population basis, people in the 55+ age category make trips at a higher rate than those in the other age groupings. Women in the 25 to 54 age category, who have the highest trip rate among the riders, rank fifth when one takes into account the large percentage of the area's population they represent.

Comparison

The proportion of riders in certain age groups varies considerably between the systems studied. The most striking differences between the two systems are the percentages of men 25 to 54 and women 55 and older (Table 1). Of the riders on the park-and-ride system, 33 percent are men age 25 to 54; only a little more than 5 percent of the dial-a-bus users are in this group. In contrast, the proportion of older women is much higher on the dial-a-bus system; 34 percent of the riders on the dial-a-bus were women 55 years of age and older, but only 4 percent of the riders on the park-and-ride system are in this group.

Generally the riders on the park-and-ride system are younger than those using the dial-a-bus. Approximately 37 percent of the dial-a-bus users and only 8 percent of the park-and-ride users are age 55 and older. The total trip rates per rider are generally somewhat higher for park-and-ride users. The trip rates for shopping trips are negligible for park-and-ride users but are somewhat over one-half trip per week for the dial-a-bus patrons. This confirms the notion that the park-and-ride system is designed to service peak-hour needs.

Although the trip rates per rider are approximately of the same magnitude for both systems, the trip rates per resident are much higher for the Batavia system. The rates for female residents are almost 100 times larger for dial-a-bus users, and the rates for men are about 25 times larger for dial-a-bus users than the comparable rates on the park-and-ride service.

Demand Sensitivity to Fare Changes

Questions on both the dial-a-bus and park-and-ride surveys were designed to obtain information on whether fare increases or decreases might significantly affect the riding habits of the present users.

Batavia Dial-a-Bus

Respondents to the dial-a-bus questionnaire were asked, At what maximum fare would you continue to use the B-Line? Respondents were also asked, At this maximum, how many one-way trips per week would you make (using the B-Line service)? Table 1 indicates the maximum fare acceptable to the riders and their anticipated rate of use at this maximum fare. Clearly, ridership rates would not substantially change at these higher fares. In addition, generally women are more sensitive to fare changes, and older women react less strongly to fare increases than younger women.

Henrietta Park-and-Ride

In this survey, riders were asked, How many one-way trips would you make for a given purpose if the cost were 10 cents less, 10 cents more, 15 cents more, or 25 cents more?

It appeared that there were some difficulties in understanding the question, particularly by older riders whose response rate to this question was lower than that of the other groups. Older riders are the most sensitive to fare increases, but generally all groups responded strongly to fare changes. The results of the questions on sensitivity to fare changes are given in Table 1.

Riders' responses to the question, How did you obtain service? revealed that more than half of the riders did not make use of the parking facilities available to them because they extensively used kiss-and-ride (the park-and-ride user's spouse drives the user to the bus stop and has the use of the car for the remainder of the day) and a large number of people walked to the bus stop.

Responses to the question, How far did you travel to reach the park-and-ride lot? indicated that most riders lived fairly close to the point at which they boarded the bus. Of the 253 people who answered this question, 202 traveled less than 4.8 km (3 miles), and only 27 traveled more than 6.4 km (4 miles) to obtain service.

Comparison

It appears that the format of the question on fare sensitivity as asked in Henrietta was somewhat better than that used in Batavia. In both surveys, however, there were surprising responses. In Batavia, the respondents 25 to 54 indicated that they would increase their use if the fare were increased, and, in Henrietta, the respondents 55 and older replied that they would decrease use if the fare were lowered. The surprising response in Henrietta was caused by the small number of people in this category who answered the question; the response in Batavia was probably caused by misunderstanding of the question.

In both surveys, women of all age groups responded more strongly to fare increases than did men of the same age group. The major difference between the results of the two surveys occurred in the responses by the 55 and older group. In Batavia, the older riders were mildly sensitive to fare increases and had an elasticity of approximately -0.53. In contrast, the older users of park-and-ride reacted very strongly to fare increases and had an elasticity of approximately -3.5.

Demand Sensitivity to Gas Price

Batavia Dial-a-Bus

The questionnaire also obtained an estimate of weekly ridership use if the current gasoline price increased to \$0.20 and \$0.26/liter (\$0.75 and \$1.00/gal). The results showed little or no change in ridership use rates under each of those circumstances, contrary to what might have been expected.

Henrietta Park-and-Ride

In response to the question, Would you make greater use of park-and-ride if the price of gasoline increased to \$0.26/liter (\$1.00/gal)? approximately one-fourth of the respondents answered that they did not know or were not sure. The remaining 75 percent of the responses were evenly divided between those indicating that ridership would increase and those who would not make additional trips. The responses to the question, Would you make

Table 1. Population use rates, percentage of riders, and dial-a-bus and park-and-ride ridership use rates based on fares for male and female age groups.

Item	Men			Women		
	16 to 24	25 to 54	55+	16 to 24	25 to 54	55+
Population use rate^a						
Dial-a-bus	0.03	0.02	0.01	0.16	0.11	0.13
Park-and-ride	0.0014	0.0007	0.0026	0.0019	0.0008	0.0021
Riders, percent						
Dial-a-bus	4.62	5.20	2.89	21.97	31.21	34.10
Park-and-ride	6.53	33.06	4.89	23.28	28.16	4.08
Dial-a-bus						
Present fare, cents	54	49	45	42	49	51
Maximum fare, cents	67	67	57	56	61	62
Ridership use rates^b						
Present fare	6.0	6.6	5.0	5.8	5.9	5.5
Maximum fare	5.6	7.5	4.2	3.8	6.0	5.2
Park-and-ride						
Present fare, cents	60	56	62	57	62	59
Ridership use rates^b						
10 cents less	6.56	7.62	6.17	7.95	8.12	6.00
Present fare	6.38	7.59	7.92	7.91	8.57	7.10
10 cents more	5.88	5.91	4.17	5.44	5.83	2.00
15 cents more	3.88	4.38	2.83	4.02	3.42	1.70
25 cents more	3.31	3.52	2.67	2.93	2.12	1.00

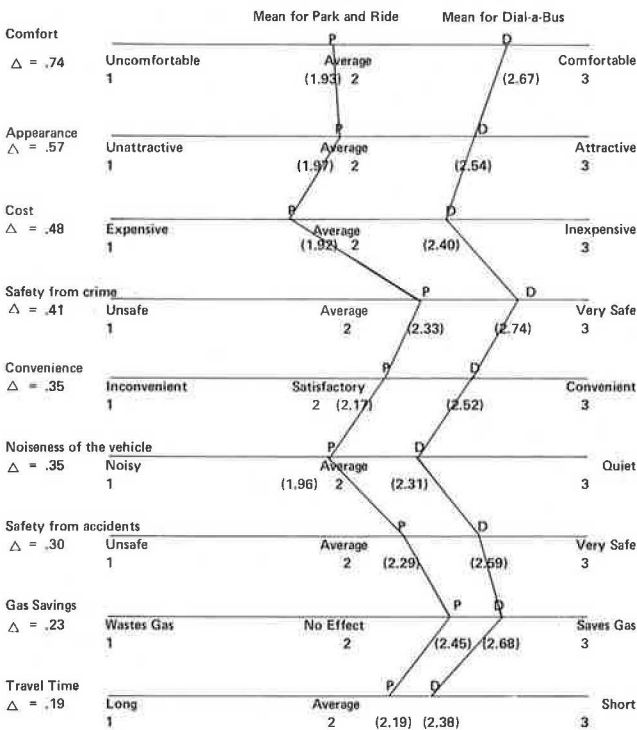
^aTrips per week per resident.

^bOne-way trips per week.

Table 2. Park-and-ride users indicating given attribute as most important.

Attribute	Male	Female	Total
Vehicle noisiness	—	—	—
Comfort	3	3	6
Vehicle appearance	—	—	—
Ride cost	11	13	24
Service convenience	23	33	56
Trip travel time	5	6	11
Safety from crime	—	3	3
Safety from accidents	3	5	8
Gasoline savings	9	14	23
Parking fees savings	3	6	9
Service reliability	16	26	42
Scheduled arrival times	12	8	20
No need for extra car	17	14	31

Figure 1. Dial-a-bus and park-and-ride attitudes.



greater use of park-and-ride if gasoline rationing were introduced? were similar, although there was a slightly higher percentage who were unsure of the effect on their use of park-and-ride under this policy.

Satisfaction With System Characteristics

Batavia Dial-a-Bus

In Batavia, the riders' attitudes indicated satisfaction with the present service. The greatest dissatisfaction was expressed about the cost of the ride and the convenience of the service and represented only 6.2 percent

of the riders in each case. The least amount of dissatisfaction, on the other hand, was expressed for the vehicle comfort and safety from crime.

Henrietta Park-and-Ride

As in Batavia, the riders' attitudes generally indicated satisfaction with the present service. In Henrietta, the greatest dissatisfaction was expressed about the comfort and the cost. Approximately 15 percent of those who answered this question selected the choices uncomfortable and expensive. Other attributes of the system that were rated below average were appearance and noisiness of the vehicle. The least amount of dissatisfaction was expressed about safety from crime, safety from accidents, gasoline savings, and savings of parking fees. In each of these cases, less than 4 percent of the respondents were dissatisfied.

Possibly a more important question is, What aspect of the service is most important to the rider's reactions? Thus, for example, a person might feel that a vehicle was noisy but that this fact might not be of sufficient importance to influence mode choice. Table 2 indicates convenience and reliability are the most important characteristics of the service.

Comparison

It appears that the riders on the Batavia dial-a-bus system are happier with their service than the riders on the Henrietta park-and-ride system. For most attributes, riders on the Batavia system had a lower percentage of unfavorable responses and a higher percentage of favorable ones than did the respondents on the Henrietta system. Riders on dial-a-bus were most dissatisfied with the cost of the ride and the appearance of the vehicle, and riders on the park-and-ride system were most dissatisfied with the cost of the ride and the comfort of the vehicle.

Figure 1 shows a more complete picture of rider attitudes toward each of these characteristics and shows that, generally, the riders on the dial-a-bus system are more pleased with their service than those on the park-and-ride system. For each characteristic, a value of three was assumed for the response that indicated much satisfaction, a one for a response that was dissatisfied,

and a two for a neutral response. The attributes are listed in order of the decreasing differences in mean responses between dial-a-bus and park-and-ride. For all attributes, the mean response by dial-a-bus users is more favorable than that of park-and-ride users.

A possible explanation of this phenomenon is that the users of the dial-a-bus in many cases had much less mobility before the introduction of dial-a-bus, and park-and-ride users in most cases could have made their desired trips by automobile or ordinary transit service. Thus park-and-ride users are subconsciously comparing their service to automobile service, and dial-a-bus riders compare their current situation with the past when a relatively expensive taxi was the only possible mode for many of the riders. Under these conditions, it is not surprising that the dial-a-bus users are more pleased with their service.

The mean responses closely agree for attributes that both groups rated high, such as safety from accidents and gas savings; for attributes that both groups rated relatively low, such as noisiness of the vehicle; and for attributes that both groups rated slightly above average, such as travel time. One of the reasons for the great disparity in the evaluation of comfort by the two groups is that all buses on the dial-a-bus system have approximately the same comfort level, but buses on the park-and-ride system may have either soft or hard seats.

Preferred Service Improvements

Batavia Dial-a-Bus

Riders were also asked about features they would like to see added to the service and about their attitudes toward certain characteristics of the present service and vehicles. The most frequently selected service feature was special buses and service for the elderly and handicapped. This is important in considering future alternatives open to the system. More important, perhaps, is to note that nearly as many riders chose to indicate their own desired feature and that these responses generally referred to a desire for more service: weekend service and more trips to particular destinations, especially to the area's community college. The survey does not provide information on the possible increase in use that might result from the implementation of these features, but it is clear that service reductions would not meet with the approval of system users.

Henrietta Park-and-Ride

In Henrietta, riders were asked what features they would like to see added to the present park-and-ride service. The greatest interest shown was in a late bus leaving the city of Rochester at 7:00 or 7:30 p.m. Forty-four of the 139 women and 8 of the 109 men were most interested in adding a bus at midday. In contrast, there were almost twice as many men as there were women who indicated they would most like to have coffee and doughnuts available on the bus. Slightly more women than men were most interested in bus service on Saturday. There was relatively little interest in buses to special events.

Comparison

Comparison of the two sets of responses is difficult since the choices were different in both samples. The fact that the nonresponse rate was twice as high in Batavia may indicate that many of the choices offered in the Batavia

survey did not appear to be significant improvements. In Batavia, only special buses for the elderly had a significant appeal. In contrast, strong support was given to several choices by the respondents in Henrietta.

Written Responses

Just as the responses to the above questions give some indication of the riders' attitudes toward the service, written comments also are important indicators of rider attitudes.

Batavia Dial-a-Bus

A categorization of the written comments permits some comparisons to be made with the previous attitudinal data. Of those dial-a-bus riders who wrote a specific comment, the most frequent comment referred to the length of time that passes between the request for service and the vehicle's arrival. All of the 17 comments on this subject can be classified as complaints: the bus was too early and the rider would miss the ride or the bus was late and got the rider to his or her destination late.

The second most frequent comment concerned the convenience of the service. These comments were all favorable and indicated either that the service was available when needed or that particular activities could not be undertaken without the service. Only two written comments referred to special service or benefits for the elderly or handicapped; however this characteristic was selected as the most desired feature that could be included in the service.

Henrietta Park-and-Ride

Written comments are particularly important since they reflect the issues that are most important to the riders. The riders, by taking the extra effort to comment, are trying to ensure that someone is aware of their thoughts on the subject they address in their comments. Thus one would expect that the service attributes discussed by the riders in their comments would be those that riders indicated were the most important characteristics.

There is indeed a strong correlation. The attribute considered most important by the largest percentage of those using park-and-ride was convenience, and most comments dealt with route and schedule changes. Similarly the attribute considered most important by the second largest group of riders was reliability of service, and there were many written comments about the reliability of service. The third largest group of riders considered the elimination of the need for an extra car as the most important service characteristic. To some extent this is reflected by a number of the miscellaneous comments in favor of buses that formed the second largest group of comments.

Comparison

The written comments by both the users of the park-and-ride system and the dial-a-bus service indicated a deep concern about the convenience and reliability of the service that they use.

In the Batavia survey, waiting time (reliability), convenience of the service, and general comments in favor of the system were the most prevalent responses. Similarly, in the Henrietta survey, route and schedule changes (convenience), general comments in favor of the system, and comments on the reliability of the service were the most prevalent responses.

This agreement is a partial confirmation of the re-

sults of other studies (3, 4, 5) that have shown that reliability, frequency, and convenience are major concerns of transit users.

Comfort appeared to be of much greater concern to park-and-ride users than to dial-a-bus users. There were several comments about the seats, the need for air conditioning, and the need for enforcement of smoking regulations. There were almost no comments in these areas by respondents on the Batavia system.

CONCLUSIONS

Batavia Dial-a-Bus

1. Most riders are women;
2. Most riders use the subscription service;
3. Men use the system most frequently;
4. Riders are insensitive to changes in gasoline prices, and this implies that they are captive;
5. The riders would not substantially change their habits if the price of a one-way trip increased by as much as 10 cents;
6. Special buses and services for the elderly and handicapped and more frequent service are generally the most desired improvements to the present service;
7. Riders were generally satisfied with the vehicle and service, were dissatisfied with vehicle noisiness, and reacted most favorably to the safety from crime aspect; and
8. General unreliability of the service was the aspect most frequently commented on, but this was balanced by comments on the basic convenience and necessity of the service.

Henrietta Park-and-Ride

1. Most riders are women;
2. Most riders use a 10-trip discounted ticket;
3. Females 25 to 54 use the system most frequently;
4. Riders, particularly those who are 55 and older, would react strongly to a fare increase;
5. Ridership would increase somewhat if gasoline rationing was introduced or if the price of gas rose to \$0.26/liter (\$1.00/gal);
6. More than half the riders do not park their cars in the lot available for them;
7. Almost all riders travel less than 6.4 km (4 miles) to obtain service;
8. A late bus is the most desired improvement, but women are more interested in additional midday service;
9. Most dissatisfaction was expressed over the comfort and cost of the ride; and
10. Most important service characteristics were convenience and reliability of the service.

Comparative Conclusions

1. More men use park-and-ride than the dial-a-bus;
2. More elderly women use dial-a-bus than park-and-ride;
3. Park-and-ride users are more concerned about the comfort of the service than dial-a-bus riders;
4. Trip rates per rider are generally higher for park-and-ride than for dial-a-bus;
5. Trip rates per resident are much higher for the dial-a-bus than for park-and-ride;
6. Older riders on dial-a-bus are much less sensitive to fare changes than older riders on the park-and-ride services; and
7. Riders on the dial-a-bus rated a higher percent-

age of attributes of their service favorably and a lower percentage of attributes unfavorably than did users of park-and-ride.

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FAIRTRAN: Operation of a Credit-Card Transit Fare System

Gary Nelson, RRC International, Inc., Latham, New York

An Urban Mass Transportation Administration demonstration project has been implemented in the Lower Naugatuck Valley of Connecticut. The purpose of the demonstration was to provide a unified public transport service aimed primarily at the needs of health and social services and their clients. An entirely new fare system was devised to overcome problems in the pricing of multiple, coordinated service modes, to provide for accountability to third-party fare support sources, and to put into practice new ideas on fare equity and pricing. The fare system, FAIRTRAN, involves use of punch-coded credit cards specially issued for the project. Ride data are recorded on magnetic tape cassettes on board the vehicles and are processed remotely at a central computer; rides are billed monthly. An option, Fareshare, allows selective financial support of individual riders in contrast to shotgun subsidies now in practice. The demonstration has shown the system to be workable. Operational changes in hardware and software will be made in a second 3-year demonstration. As yet, fare system costs appear to be several times higher than conventional coin system costs, but benefits of data collection, elimination of coin handling (and out-of-pocket bias), pricing flexibility, and Fareshare have to be considered on balance.

Are present transit fares fair to either operators or users of transit? The search for fair transit fares is what first motivated the design of what is called the FAIRTRAN system. The specific context in which FAIRTRAN was developed, and is still developing, is the Valley Transit District (VTD) in Connecticut, where an Urban Mass Transportation Administration demonstration program has been in operation since late 1972.

In brief, FAIRTRAN contains several components and concepts that together constitute a complete revenue collecting and accounting system. Instead of cash, users use a wallet-sized, plastic, punch-coded credit card, the V-card. The five-digit punch code represents a user identity code. On board the transit vehicle is a service recorder or FAIRTRAN box (Figure 1), which generates and records data on rides. The driver may input geographic, modal, and other data into the box through push buttons or special punchcards. The user inserts the fact that he or she is taking a ride by means of his or

her V-card. The box internally generates a time signal. These data are recorded together on a magnetic tape cassette. Because the user enters the card on entering and exiting, data are recorded for both ride ends.

The ride tapes from the box are then machine processed on a daily basis to recreate individual rides from the interleaved data strings. These rides are then priced according to a particular, and possibly complex, pricing formula. Rides of individual card holders are cumulatively stored over the monthly billing period. Each month, the accumulated charges are billed by mail to the user who makes a remittance (Figure 2). Currently only door-to-door trips are billed to individual users, but any of the modes would be listed with trip date, time, end zones, and price. In Figure 2, the customer price is lower than the total cost because of the Fareshare discount; the discounted amount will appear on another bill to the third party funding source that will indicate the same ride data listed by individual users. The FAIRTRAN information flow is shown in Figure 3.

Part of the pricing algorithm, but so important that it deserves special mention, is the Fareshare option. Fareshare is simply a means of allocating payment of a fare to multiple payors. However, it is only because of the nature of FAIRTRAN that it is possible to actually have separate entities participate in the payment of fares on a case-by-case basis. The significance of this should be seen in the instance of a service agency that might want to reimburse a client for trips to a service center. FAIRTRAN with Fareshare is the means whereby this can be accomplished with a high degree of accountability (for instance, geographic or time checks to see if a ride was indeed for a specified purpose), a high degree of specificity (perhaps the Fareshare is to be proportional to user income), and without a cash or pseudo-cash (ticket or pass) flow through the user. The features of accountability and selective subsidy have had the substantial benefit of attracting new money into the transit operation of VTD. Along with the UMTA demonstration, a U.S. Department of Health, Education, and Welfare demonstration is operating in the valley. HEW moneys have been devoted to funding agency use of VTD in a test of the integrated transport service concept. Without the Fareshare mechanism, it is doubtful that the HEW, or local agency,

Figure 1. On-board FAIRTRAN service recorder.

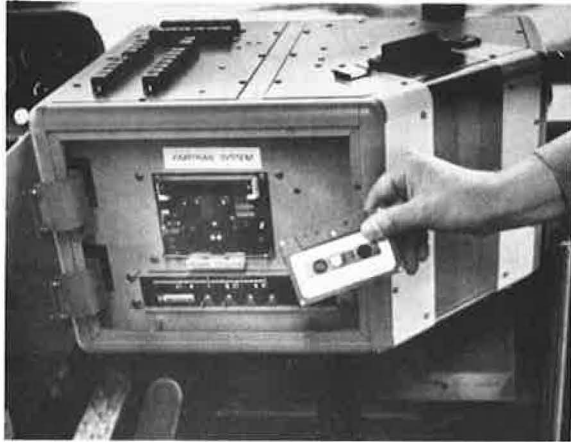


Figure 2. User bill generated monthly by FAIRTRAN.

Valley Transit District

To: RUHNS, ELSIE
65 CONGRESS AVE.
SHELTON, CONN., 06484

Customer ID: 11431

Pay this amount: \$1.26

Thank you

----- To insure proper credit, please return above portion with your remittance -----

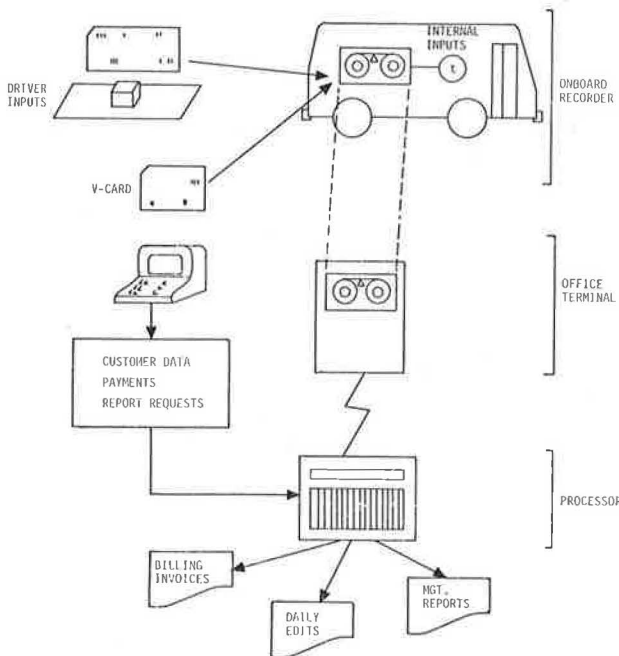
Date	Start Time	Origin/Destination	Total Cost	Cost to Customer
04/19	10-4:15AM	G2 F2	.48	.39
04/19	2-3:30PM	F2 G2	.45	.36
04/25	1-4:30PM	G2 F2	.38	.31
04/25	3-4:30PM	F2 G2	.25	.20

AVERAGE PRICE ON DOOR-TO-DOOR RIDES: .31

Previous Balance: .00 + Scheduled Route: .00 + Rent-a-bus: .00 + Door-to-Door: 1.26 + Deposits: .00 = Pay this amount: 1.26

Valley Transit District

Figure 3. FAIRTRAN information flow.



money could be attracted into VTD. The significance of Fareshare as an alternative to present reduced fare programs will be discussed below.

VTD DEMONSTRATION

FAIRTRAN evolved integrally with the operational requirements of VTD. Although FAIRTRAN system and concepts are presumed to have further application beyond the VTD, a full understanding of FAIRTRAN requires some understanding of the goals of VTD.

The VTD demonstration operates in Connecticut in the Lower Naugatuck Valley region. This region is north of, and between, the cities of New Haven and Bridgeport in southwestern Connecticut. The region consists of four towns: Ansonia, Derby, Seymour, and Shelton, which constitute a Council of Governments. The region had a 1970 population of 73 700 and an area of 145 km² (56 miles²). The UMTA demonstration began in July 1971 although vehicular operations began only during Christmas week 1972. FAIRTRAN itself became operational on March 26, 1973. With a 3-year extension starting July 1974, VTD became the first UMTA 6-year demonstration program.

The motivation for VTD came from the health and social service community of the valley in the 1960s. The VTD demonstration has always had the service of the elderly, handicapped, and other agency users as a prime objective. However, service to the general public has never been excluded.

The VTD demonstration was planned by RRC International. Sections of RRC involved in computer systems, electronics, and transport planning worked jointly on FAIRTRAN implementation. J. Woodhull, now with the Southern California Rapid Transit District, developed the original FAIRTRAN and service concepts. I served to develop the system and analyze its results. The two ideas of the multimode service, to achieve VTD goals and to pursue equitable fares, led to FAIRTRAN.

Four service mode concepts were first proposed for the VTD: shuttle (a fixed route), door-to-door (a demand service), hitch-a-ride (jitney service), and rent-a-bus (a charter or contract type of service). These multiple services would serve the needs of the general rider in the core area, the rider requiring door-to-door service over any part of the valley, those who could hail a demand vehicle, and groups or agencies. The two fare considerations arising from this mix of services were how to selectively charge different types of riders (particularly those allied with an agency versus the general public) and how to allocate and coordinate the mix of services through a price mechanism. In addition, the service mode concept changed in the course of the demonstration. The shuttle ran only briefly, up to the start of door-to-door service, and during the strike of the operators who previously drove the public transportation vehicle in the primary fixed-route corridor in the valley. However, a network of fixed routes is being established for the follow-up demonstration. Door-to-door service was never a dial-a-bus service, which is a long request time-lead service and requires high per-rider service subsidy. Distinguishing the subscription portion of door-to-door service from the "call-in" demand service became important. Hitch-a-ride never came to fruition because there were never enough vehicles (never more than six in service) to make hailed service practical. Rent-a-bus carries on as both the occasional rent-a-bus under FAIRTRAN fares and a regular contract service that is given for a lump-sum price billed through FAIRTRAN.

The other considerations leading to FAIRTRAN related to fare equity particularly in the demand service. The

philosophy behind the FAIRTRAN fare algorithms is strictly opposed to the idea of flat fares. Although simplicity considerations, and indeed misguided equity and incentive considerations, have resulted in a trend toward flat fares, I think that flat fares have severe drawbacks.

The economic bases for transit pricing are muddled because, given that transit is increasingly a social service rather than an economic venture, pricing considers social costs and benefits that are poorly defined. It seems that social equity requires low fares, and, as long as fares are reasonably low, they can be flat. Economists have argued that average cost pricing is the only method feasible for fixed routes; this gives some credibility to the flat fare. However, the problems with flat fares are several. Even in fixed routes, it is entirely probable that the user perceives rides as being of different value for different distances. If there is any sort of conscious price comparison in modal choice, flat fares probably result in the loss of many potential short riders. On the other hand, there is a possibly excessive consumer surplus for long riders. Consider systems like AC Transit, which boast rides of over 161 km (100 miles) for the base fare, with transfers. In a radial system, longer rides tend to be taken by the more affluent in suburban areas, and, because of this, flat fares can in fact be an inequitable transfer of wealth. Flat fares, despite their touted simplicity, create the complexity of transfers. If each ride segment were priced in an incremental fashion, the rationale for transfers would be substantially reduced.

For demand service, the problems with flat fares are more severe. There is a marginal price associated with a demand service ride. Because demand service is very capacity limited (not by vehicle capacity but in terms of riders per time that can be served), serving one ride effectively means foregoing another ride. Each ride requires an increment of service capacity (vehicle-hours). If demand service is provided over a relatively small, homogeneous area, single-price service may not be too bad. However, in the VTD, transportation needs to serve a 145-km² (56-mile²) area including farmland and dense core areas, and variable pricing was clearly necessary. (It is not to be inferred that pricing was the only problem in providing the demand service over that area.)

With the mix of services, service allocation and coordination were also a problem. What would be the transfer arrangements between a shuttle route and a demand vehicle? Could market mechanisms, rather than administrative restrictions, be used to allocate rides between demand and fixed-route services? The experience of the Santa Clara County District, which charged a flat \$0.25 on both fixed-route and demand services and consequently overloaded the demand service while minimizing total passenger service, is instructive.

Clearly, Fareshare is an integral part of the FAIRTRAN pricing possibilities. The equity of lower fares for specific user groups, such as the poor, the elderly, and the handicapped, is only consistent with service allocation prices if the needy groups can selectively be charged proportionally less. There is a more fundamental benefit in the Fareshare approach to reduced fares. Currently, reduced or blanket-low fares have a hidden inequity. Fare reductions currently are financed out of the pool of transit funding moneys that could be used for better service. Better service, as is known, is more effective than price in determining transit use. This sacrifice of service for price is inequitable in that the fare reductions usually take no account of user income, which should be the only criterion of fare reduction qualifications, and therefore, the im-

PLICIT transfer of income cannot be very equitable. But fare reductions act to benefit those already with service at the cost of those who could potentially have service. The benefits of lower fares in the case of diverted motorists or elderly riders are played up; however, the motorist still in his or her car or the poor person who must use a taxi because of poor service is entirely overlooked. It is reasonable to say that equity and benefit are maximized by the greatest selectivity in fare discount. This is one function of Fareshare that can grant specified discounts to individuals based on any detail of need data that can be collected and put in a data bank as part of the credit-card application process.

But Fareshare goes beyond this. Another major goal of VTD was to integrate existing moneys, other than transit funds, into the VTD operation. These moneys included those for previously fragmented agency-run transport services and moneys going to health and social services, for which a transport service component was implicit. As mentioned, it was largely because of Fareshare that a substantial HEW grant was obtained for the valley for use in VTD-provided transport. The present problem in fare reduction requirements for the elderly and handicapped, as in the UMTA Section 5 program, is that transit is being required to provide a social welfare function in income redistribution in conflict with its primary social function of providing a service. If there are reasons for providing this income redistribution through transit, it might be expected that individual agencies, with additional money, should provide this function through a process like Fareshare. It seems that sentiments for specific user groups have been more effective than the wider benefits of transit in getting public financing of transit. By specifically directing funds to various user groups, Fareshare might further use these sentiments for the sake of transit.

The specific fare structures used for VTD are basically three types. For the fixed-route services there is a time-based fare. A small, fixed, pickup charge is levied plus some constant rate times ride time. Because use of the fixed routes by coin is allowed, on a simple base fare plus zone charge, the FAIRTRAN fare is truncated to never exceed the coin fare. An additional fare feature is a group discount whereby the V-card user can make a multiple insertion for each rider in his party. A 10 percent fare discount is given to each rider after the first. Fareshare can be applied to any V-card user as a percentage discount from the calculated fare. In operation, the Fareshare discounts were primarily related to age, handicap, or need for medical service and ranged from 20 to 100 percent in some cases. These reduction criteria were generated by the HEW project and, it is admitted, partly ignore the Fareshare rationale.

The rent-a-bus mode has a time-dependent fare that includes both deadhead and user travel times for the entire bus. For groups without V-cards, rides can be billed on a special, driver-inserted punch card. The contract services sold for a prearranged lump sum will generally bypass the on-board recorder but are billed through the FAIRTRAN billing process. Fareshare could be applied to these modes also.

The door-to-door service developed the most complex pricing. In retrospect, the pricing may indeed have been too complex. A ride on the demand service had three price components: a predetermined charge dependent on which geographical zone the pickup was in, a charge for the particular zone-to-zone interchange of the trip, and another charge for the particular drop-off zone. There were 33 zones that were input to the FAIRTRAN box through the driver's push buttons. The pickup or drop-off charges were based on how outlying a zone was, that is, some estimation of the likelihood of having to go

to that zone to serve another ride anyway. Outlying zones had higher charges than core zones since demand density was lower in the outskirts. The zone-to-zone charge came from a predefined matrix based on nominal direct service times between zones. This eliminated any user charges due to delay or diversion to serve other riders that would result from a direct time-based charge.

In addition to the three basic charges, there were three reduction factors. The popularity factor reduced the pickup or drop-off zone charges in proportion to the number of persons actually picked up or dropped off in a specified time interval. The occupancy reduction applied a discount to the zone-to-zone charge proportional to the time average of persons on board the vehicle. There were also the group ride and Fareshare reductions. Hitch-a-ride was charged as a modification of the demand service price, a fixed reduction was applied to the zone-to-zone charge, and a fixed nominal pickup and drop-off charge was made. However, the hitch rider had the option of specifying a drop-off rather than going where the bus might. A regular drop-off and ride charge was then assessed.

The form of the popularity and zone-to-zone reduction factors is of particular interest. The original form was $(k + a)/(k + x)$, but this was later changed to $(a/x) + k$, where a and k are constants and x is the parameter relating to popularity or occupancy. The actual reduction factors used could in fact be almost any form. The important thing to note is how the individual fare and the total vehicle revenue collected vary with x . As x increases (roughly more users per vehicle-hour), the reduction factor and the individual fare decrease. However, if the constant parameters are adjusted, the reduction factor can decrease less slowly than x increases. This means that, as use increases, individual fares decrease and total revenue increases—an incentive to both user and operator to increase use.

Note that, although the fixed and charter types of modes have, in principle, predictable fares, the demand service is not predictable. A user will not know a priori how much a ride will cost because the charge depends on ride decisions of others.

OPERATIONAL EXPERIENCE AND MODIFICATIONS

The FAIRTRAN system grew entirely with the demands and possibilities of the first VTD demonstration. Many difficulties have since been identified and are to be overcome, it is hoped, in the present demonstration phase.

By mid-1975, FAIRTRAN had processed over 50 000 rides for almost 4000 users. The overall reliability of the system, in terms of valid rides output for billing, has fluctuated but has increased to better than 95 percent of all rides. The problems of lost rides have come almost entirely from the farebox and its interfaces. Often the rider may forget to insert his or her card, usually on exit rather than entry. However, increased watchfulness of drivers and experience of riders have gradually decreased this. Unmatched rides (rides with a V-card insertion on only one end) can usually be recreated from dispatcher data anyway.

More serious problems have been in the use of the farebox mechanism. There is a leader on the tape cassette, and, when the cassette is emplaced, the leader is not always fully wound over, and data are lost. Sometimes the tape head is not shut, and data for a complete day are lost.

The power supply to the box has been very erratic:

Sizable voltage pulses make power input conditioning difficult, low battery voltages may make the system inoperable, and extreme cold has sometimes produced spurious results if the electronics are not brought to a reasonable temperature. Since the data are generated in strips of multiple words, offsetting a digit by one place in a word because of some malfunction will throw off a whole data string. Because the clock in the box requires a constant power input, when the battery disconnects the time signal is often no longer synchronized. However, if human error and power input problems are discounted, the boxes have been highly reliable overall.

In the present system, a computer of a local industry is used to process the FAIRTRAN data and generate the bills. Because of an initial change in plans, the code of the box cassettes is incompatible with the computer code. Therefore, a conversion step of cassette magnetic tape to recoded paper tape must be made. This step has introduced error and inconvenience.

In credit card use, the default rate may well be questioned. At present there are about 4000 V-cards issued. The user group is somewhat select, primarily regular riders or persons associated with agencies. However, the default rate on payments has been only about 3 percent of gross receipts. This is surely not insignificant, but it probably compares favorably with skim and other losses in conventional fare systems. It can be argued that eliminating the out-of-pocket bias of transit fares through credit also generates more than an added 3 percent in revenue on a given system.

Fare transaction times were a consideration in FAIRTRAN design. It was hoped that the elimination of coin and ticket handling would reduce this transit delay component. Boarding times were measured as 4.8 s/person on a conventional transit system in Albany that uses a simple base plus zone fares. For FAIRTRAN, 4.08 s/person was the average for boarding times, and 4.2 s/person for alighting times. Unless the alighting V-card transaction can be conducted entirely before the bus stops (an unsafe practice) or in a two-stream arrangement, the two-transaction nature of FAIRTRAN can mean up to a doubling of fare-transaction time.

It is now believed that too much is asked of the drivers in operating FAIRTRAN. The driver not only must perform demand service duties, in particular, but must input zones, select other modal and special inputs, input special cards on occasion, and check V-card transactions. Particularly in larger systems, it is desirable to reduce the driver responsibilities. Removing cassette loading responsibilities from the drivers has already increased reliability.

User reaction to FAIRTRAN has been clear in distrust of the demand fares. There can be large variances in fare, even on the same ride, particularly because of the sharp cutoff of the popularity reduction factor (a 3-min interval). Two people riding subscription service the same way each morning could have fares varying by 50 percent or more if the time separation of their getting on or off exceeds the reduction time window by just a fraction. Because FAIRTRAN bills are itemized by ride, riders begin to suspect that the pricing is capricious. Therefore, the public seems to want determinant fares, and some people feel better about going back to cash fares entirely. However, public sentiment has not been adequately quantified on this matter yet.

Apart from the indeterminacy question, was the original demand price structure proper? It is now felt that having a predetermined, and somewhat arbitrary, set of endpoint and zone-to-zone charges is a shortcoming. Furthermore, popularity and occupancy reductions are somewhat redundant, eliminating dependency on geographic inputs to the box is desirable, and use of sharp

popularity discount time windows is unwise. An entirely satisfactory pricing algorithm attempting to allocate marginal costs of demand service has not been devised; however, I have proposed an algorithm based on time-localized vehicle productivities measured as a productivity (riders served per time), in which riders are weighted by a nonsharp, decreasing time function centered on the subject users. That is, riders who board or alight later than the subject rider are worth less in the subject rider's discount. This endpoint-based pricing could be freed from geographic inputs. The presumption is that the real marginal cost is in serving the ride endpoints, not in the ride itself. Endpoints with low productivity are priced higher.

Data collection must also be cited as a major FAIRTRAN benefit. FAIRTRAN will give data on rider identity, any rider demographics that can be recorded as part of the V-card registration process, ride endpoint time, ride endpoint zones, and, by aggregation, any vehicle centered data derived from ride data. In the VTD demonstration however, these data for system management have not been used as much as possible. Because analysis programs have not been produced, except for the project final report, there has been no convenient way of using FAIRTRAN data for system analysis. In addition, the data were not oriented toward vehicle time as opposed to user time; therefore, important factors like overall vehicle productivity were not readily derivable.

The reduction factors in the demand pricing formula, which resulted in the fare indeterminacy, were conceived as user incentives; however, this is only true if riders can reasonably influence others to ride. Although this may occur in some long-term or fortuitous way, by and large people will feel randomly penalized by the occurrence of low-use rides with concomitant high fares, rather than feel rewarded by low fares on high-use rides.

Ultimately the real question for FAIRTRAN concerns system cost. Probably, the benefits of elimination of on-board cash transactions, fine fare structures, data collection, and Fareshare are apparent. But how much does this cost? As a demonstration, the costs developed are not necessarily indicative of larger scale operational costs. Also, although favorable rates on computer processing were obtained from the local industry that did VTD processing at or below cost, further savings might be obtained by in-house computing.

The major cost factors are on-board farebox hardware, terminal and keypunch personnel times, V-card distribution costs and customer entry costs, billing and mailing costs, and computer processing costs. Based on VTD experience, high and low cost functions in dollars per month, depending on various options, were derived for the steady-state system (after the initial surge of V-card applications). They were as follows:

$$\text{Low cost per month} = 110 + 0.201U + 0.012R + 30.49V \quad (1)$$

$$\text{High cost per month} = 178 + 0.354U + 0.040R + 30.49V \quad (2)$$

where U is the size of the active user pool, R is the rides per month, and V is vehicle fleet size. Based on experience, the minimum foreseeable per-ride cost for a debugged system now appears to be about \$0.05/ride. The effects of economies of scale, in-house computing, and program refinement are yet to be definitely determined.

How does this compare with present costs? Based on a small sample of transit properties in Rochester, Albany, and St. Paul, fare collection and accounting costs were found to be remarkably uniform at \$0.04/

ride. It is then hard to reconcile the order-of-magnitude cost difference between FAIRTRAN and conventional systems on a per-ride basis. Note, however, that average fares on VTD were \$0.86 compared to most conventional transit fares of \$0.40 or less. Because FAIRTRAN is best suited for specialized, higher priced services, the fare collection cost as a percentage of fares is not so disparate, and the accounting of added FAIRTRAN benefits must certainly narrow the gap. Ultimately, the operator's evaluations of FAIRTRAN benefits and cost reductions would determine the operational feasibility of the system.

FUTURE DIRECTIONS

The next phase of the VTD demonstration will see a changed FAIRTRAN.

1. An in-house minicomputer for FAIRTRAN processing and demand bus dispatching will be purchased. This will reduce processing costs and greatly increase system accessibility.
2. Direct cassette-to-machine data transfer will be made possible.
3. Driver input of vehicle time-use data to the box will be limited, and dispatchers will input zonal data.
4. Reliability of the box will be improved through re-design and fail-safe features.
5. Fare structures will be modified, and demand fares will be determinant.
6. Data analysis programs will be produced to facilitate use of FAIRTRAN data in the management system.
7. Coin fare accounting will be incorporated into the system.
8. Fareshare will be modified to allow possible direct use of funds such as medicaid transport funds.

In summary, RRC developed and tested, in little more than 3 years, an entirely novel transit fare system, from concept to implementation. FAIRTRAN is already moving into a second generation. VTD has, however, been a small and specialized system. Whether FAIRTRAN can have application in larger or more general systems remains to be tested in further demonstrations.