TRANSPORTATION ATTITUDE SURVEY FOR MODAL-SPLIT FORECASTING AS PART OF LONG-RANGE TRANSIT PLANNING

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The Orlando Urban Area Transit Study included a community attitude survey in its long-range transit planning process. The primary purpose of the attitude survey was to provide input to a modal-split model designed to determine patronage on a future transit system. Criteria for long-range planning of the regional transit system were obtained from potential users' attitudes. The basic information obtained from the survey is (a) attributes that the public considers important in satisfying what it perceives as acceptable transportation service; (b) minimum levels of service necessary to generate significant patronage of the future system; (c) factors that may cause choice riders to use transit rather than automobiles; (d) trip purposes for which the future public transit system would be used; (e) whether individual respondents would use a future transit system that met their specifications, as a rough indication of modal split; (f) socioeconomic groups with a greater tendency to use a future transit system; and (g) determination of automobile-captive, transit-captive, and free-choice ridership for different system alternates, trip purposes, and income levels. A pilot attitude survey of community leaders, coupled with a slide show presentation on regional public transit system concepts, preceded the telephone survey of the tricounty Orange-Seminole-Osceola region. An additional consideration in this study was that traditional calibration of a modal-split model would not be possible. Current bus service does not reflect the type of well-designed regional transit system for which we want to forecast patronage. This suggested use of a model that had been calibrated in a different urban region and that could be justified as "universally applicable" in theory. The community attitude survey served to confirm the basic assumptions of the disutility model that was adopted and provided the captive rider endpoints, thus making the model more realistic for application to the Orlando urban area.

•THE FIRST STEP in preparing the community attitude survey was a literature review of transit surveys conducted in other regions and an identification of variables that could influence modal selection and yield possible topics of questions on the survey form. The synthesis of this information, coupled with the goals of the long-range phase of the transit study, generated the first preliminary design.

The questions, wording, and layout of the survey had to provide the desired information yet be simple to implement within budgetary restrictions. The survey was designed with the following criteria in mind:

1. The questions should not require professional judgment or knowledge of transportation planning and operations to be understood or answered correctly by the respondent.
2. The questions should represent criteria that show variability.

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3. The questions should be able to quantitatively measure attitudes, relative importance, and minimum service levels desired so that results can be usefully applied to the modal-split model and long-range planning.
4. The answers should provide sufficient input to develop the modal-split model.
5. The questions should be simple and straightforward; the questions, wording, and survey format should not contain bias or cause confusion to respondents with either limited education or unfamiliarity with public transit.

The preliminary survey design was discussed with the East Central Florida Regional Planning Council and the Florida Department of Transportation. With minor modifications, the handwritten form was tested in a pilot study.

Pilot Study

The purposes of the pilot study of community groups and governmental officials were to familiarize community leaders with the long-range transit study and potential regional transit system concepts and to test the survey form and receive comments and suggestions on improving it. A slide show on futuristic transit hardware and regional public transit concepts was shown to each of the groups. The presentation emphasized multimodal "family of vehicles" concepts to indicate that we would be considering transit plans other than just more buses. Following this, attitude survey forms with a cover sheet picturing several new systems were handed out to the participants and the purpose of the survey was explained.

Participants were encouraged to offer suggestions on improving wording and layout of the survey, and many useful comments were received and incorporated into later versions of the survey. During the pilot study it became clear that, if the meaning of questions could be clarified for respondents when they took the survey, the results would be considerably more accurate and interpretation problems would be minimized. This, coupled with a review of techniques for implementing a random sample, led to the conclusion that the survey should be conducted by trained interviewers by telephone rather than by mail. The survey form was again revised to include suggestions from the pilot study group and reformatted and reworded to expedite a telephone interview and computer coding and processing.[1] The pilot study revealed that personal interaction between those administering and those taking the survey was an important consideration; therefore, a professional market research firm was hired to conduct the telephone interviews.

Sampling Technique

A sampling procedure was developed to ensure that socioeconomic groups (income levels in particular) would be proportionately represented on the survey. The region-wide percentage of households in each of five income levels was obtained from census data, and the desired minimum sample for each level was specified in the same proportion. Census tracts were then categorized by median income level, and a computer program generated a random sequence of tracts for each level, which ensured geographic randomization of the sample. Thirty interviews per tract were conducted until the sample size for that income level was satisfied. Additional controls were established for employment, sex, age, and county of residence. The overall sample size target was 1,277 interviews, approximately 1 percent of total regional households. However, additional interviewing had to be performed to obtain enough responses from the lower income groups; a total of 1,588 forms were actually processed. The telephone interview technique guaranteed reasonable approximation to our sample controls and eliminated many of the problems associated with mail-back surveys such as insufficient returns, interviewee confusion, and interviewee misunderstanding the real meaning of questions.

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[1] The original manuscript included a sample questionnaire. This questionnaire is available in Xerox form at the cost of reproduction and handling from the Transportation Research Board. When ordering, refer to XS-52, Transportation Research Record 508.

The telephone survey results were stratified by

1. Income group,
2. Car ownership,
3. Rail transit experience,
4. Bus transit experience,
5. Housing type (single- or multiple-unit dwelling),
6. Age group,
7. Sex,
8. Employed and unemployed, and
9. County of residence.

TYPES OF QUESTIONS AND MAJOR SURVEY RESULTS

Transit Use

Potential conditions in 1980 and 1990, such as increased traffic congestion, air pollution, and energy shortage problems, were described to the interviewees. They were then asked whether they would use (yes or no) a future regional transit system that met their specifications. After this general question, two broad transit concepts were briefly described: a door-to-door system and a station/stop system that the users accessed by walking or driving. (Generic names such as dial-a-bus, dual-mode, and PRT were not used because most residents were unfamiliar with their meanings.) Respondents were then asked how often they would ride each of these systems—never, infrequently, half the time, most of the time, and all the time—for three trip purposes (work, shop, and recreation) and for "all trips to downtown."

Eighty-nine percent of the total sample said that they would use a modern future transit system; the range of answers for all stratification groups was between 83 and 94 percent. It is apparent that the respondents interpreted this question as "would you ever use such a transit system?" inasmuch as a drastically lower percentage of regular use was indicated by the sample. The high response to this question should be interpreted as representing a favorable community attitude toward accepting a modern regional transit system in the tricounty area but not necessarily toward riding it regularly.

For every trip purpose, more respondents said they would regularly use a door-to-door system than a station/stop system to which they would have to walk. Respondents would use both types of systems most frequently for work trips, followed by trips to downtown and shopping trips; recreation and other trips would generate the least transit patronage. Thirty-one percent of the respondents said they would use a door-to-door system for work trips all the time; another 20 percent said they would use it most of the time. Nineteen percent of the sample indicated that they would use a station/stop transit system all the time for work trips, and another 18 percent said they would use it most of the time. Responses to direct transit usage inquiries are shown in Figure 1.

Several special groups—low income, low car ownership, women, the elderly, persons with previous rail or bus transit experience, multiple-unit dwellers, and the unemployed—indicated higher-than-average transit use in both systems, but the difference was more extreme in the door-to-door configuration.

Ranking of Transportation System Attributes

Participants were asked to rank the importance of travel time, cost, and convenience in selecting transportation mode for work, shopping, and recreation trips (Table 1). Convenience was described to them as waiting time, walking distance, time to find a parking spot, proper schedules, availability of transit to the destination, and no transferring. Travel time was defined as running time on the vehicle, and costs included parking, transit fares, tolls, and gasoline.

The respondents clearly indicated (Fig. 2) that convenience was the most important item for all three trip purposes. For every trip purpose, travel time was considered the second most important and cost the least important attribute. Convenience received its highest rating (60 percent) in the shopping trip category. Travel time received its highest rating (28 percent) for work trips, but this was still less than the 50 percent of the sample that claimed convenience was most important for work trips.

Figure 1. Use of door-to-door and station/stop transit for various trip purposes.

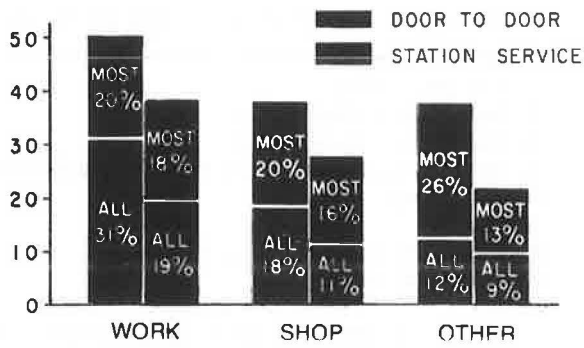


Table 1. Entire sample ranking of most important transportation attributes.

Trip Purpose	Attribute	Percentage Responding Most Important	Ratio (cost = 1.00)
Work	Convenience	50	3.85
	Travel Time	28	2.15
	Cost	13	1.00
Shop	Convenience	60	3.75
	Travel Time	19	1.18
	Cost	16	1.00
Other	Convenience	51	2.63
	Travel Time	23	1.21
	Cost	19	1.00

Figure 2. Ranking of most important attributes of transportation.

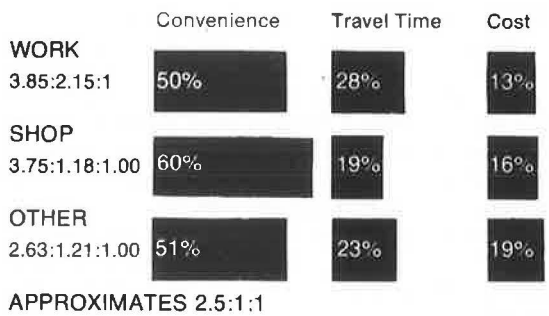
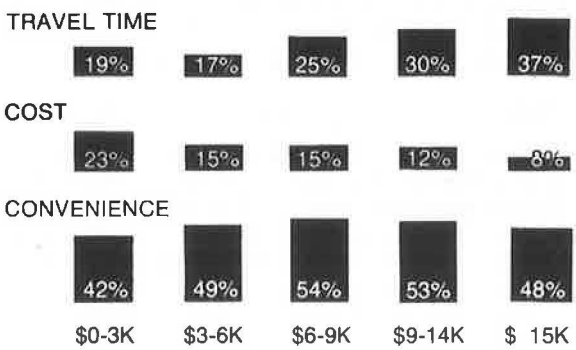


Figure 3. Importance rankings by income stratification.



Service Levels

Respondents were asked to suggest desirable service levels for walking time, walking distance, transit fares, and other items. It was felt that having the interviewee specify a service level was less biased than offering him predetermined categories to choose from.

The survey results indicated that the average time respondents would be willing to wait for a transit vehicle is 14 minutes for shopping and work trips. They would walk an average of two blocks to a transit stop and be willing to pay an average of 29 cents for a transit ride. More than 50 percent of the sample said they would not be willing to make transfers on a transit system. This is certainly an important consideration in designing a future regional system that will attract patronage.

Employed respondents were asked how long it takes them to travel to work; it is assumed that any future transit system would have to meet or exceed these travel times. As many as 27 percent can get to work in less than 10 minutes; more than 90 percent of the sample can get to work within a half-hour.

General Questions

Additional questions were included to obtain the stratifications mentioned previously to determine a profile of the sample. Over 88 percent of the sample indicated ownership of a car, and 51 percent were multiple-car households. Of those respondents who were employed, 92 percent had a car or truck available for their daily work trip, and 39 percent used that vehicle as part of their job during the day. Of the total sample, 89 percent had cars available for shopping and recreational trips.

The respondents were asked to indicate (out of a given list of 10) the three most important uses of their tax money for local services. The frequency of appearance of each tax use in the "top three" was tabulated. Health and hospitals were mentioned in 64 percent of the forms, education second at 60 percent, police third at 48 percent, and public transit fourth at 31 percent. Pollution control was next, 29 percent; followed by sanitation, 17 percent; highways, 11 percent; housing, 10 percent; welfare, 9 percent; and recreation and parks, 8 percent.

STRATIFICATION EFFECTS

Income Groups

There was a definite trend toward a higher "all the time" use of transit for all trip purposes as income decreased, although the range of values was not large. Whereas 25 percent of the lowest income group said they would use station/stop service for work trips all the time, 15 percent of the highest income group responded similarly. For the door-to-door service, the responses were 40 percent in the lowest group and 27 percent in the highest. As income increased, a greater proportion of the answers indicated "never" and "infrequent" use of the system.

The number of respondents indicating travel time as most important (for each trip purpose) significantly increased as their income increased, from 19 percent in the lowest group to 37 percent in the highest. Similarly, the percentage indicating cost as most important decreased with increasing income, from 23 percent in the lowest income group to 8 percent in the highest. These trends were most pronounced in the work trip category. However, in all stratifications, convenience remained of greatest importance. The trade-off between travel time and cost as income increases is shown in Figure 3.

The average waiting time specified for a transit vehicle decreased with income, from 17 minutes in the lowest group to 11 minutes in the highest; all groups indicated a two-block walking distance. The price specified for a transit ride increased only from 27 to 33 cents between income levels. A slightly greater percentage of the high-income group said they would not allow any transfers on the future system (44 percent in the lowest group, 52 percent in the highest). There is apparently a greater demand for certain conveniences in the higher income groups.

Car Ownership

Most of the trends related to increasing income are also exhibited by increases in the number of cars owned. Significant effects to be noted are that

1. Persons without cars indicated a willingness to wait as long as 19 minutes for a transit vehicle, whereas car owners would wait 12 to 14 minutes;
2. Use of transit "all the time" for both systems by no-car households was double that of the single-car owners for shopping, recreation, and downtown trips, and the ratio was 1:5 for work trips; and
3. A significant percentage of no-car households had cars available to them (neighbors, car pools, and so on) for shopping trips (37 percent), other trips (36 percent), and work trips (33 percent).

Transit Experience

Persons with regular bus or rail transit experience were more oriented toward using it in the future than those without experience, but they were also more aware of traditional transit problems and demanded higher levels of service. For all trip purposes, convenience was more important to previous transit users (54 percent) as compared to infrequent and nonexperienced users (49 percent). A greater percentage of the experienced group were in the "no transfers allowed" category, but travel times were relatively less important to them. More importance was placed on taxes used for public transit by persons with previous transit experience. Forty percent of the respondents who used bus transit frequently listed transit as a high-priority tax use, whereas only 27 percent of the infrequent users or nonusers did.

Other Stratifications

Residents of multiple-unit dwellings indicated 5 to 10 percent higher "all the time" use of transit in every category of system and trip purpose when compared to single-family homes; they also exhibited 20 percent lower car availability. Convenience was more important to the elderly, whereas women and the unemployed were relatively more concerned with cost and less with travel time than other groups.

CAPTIVE AND CHOICE RIDERSHIP

A major purpose of the transit use questions, for the door-to-door and station/stop systems, was to determine automobile- and transit-captive percentages; the remainder would be classified as free-choice travelers. The computer program that processed the attitude survey used the following rules to determine captive and choice respondents (by trip purpose, income group, and system type):

Type	Characteristics
Automobile captives	Need car in job; would "never" or "infrequently" use transit
Transit captives	Would use transit "all the time" and do not have car available; 50 percent who would use transit "most of the time" and do not have a car available
Free-choice travelers	Would use transit "half the time"; 50 percent who would use transit "most of the time" and do not have a car available; would use transit most or all the time but have a car available

Regionwide, the percentage of work trips was

Type	Door-to-Door System	Station/Stop System
Automobile captive	45.6	55.4
Transit captive	3.2	2.2
Free choice	51.2	42.4

For both systems and each trip purpose (Figs. 4 and 5), there is a gradual decrease in captive transit ridership as income increases, as well as a gradual increase in captive automobile ridership. For all income groups and trip purposes, the percentages of transit captive and free choice are greater for the door-to-door system than the station/stop system.

For each category, the trip purposes are listed in order of decreasing importance:

Type	Trip Purpose
Automobile captive	Recreation, shopping, work
Transit captive	Shopping, recreation, work
Free choice	Work, shopping, recreation

ATTITUDE SURVEY INPUT TO THE MODAL-SPLIT MODEL

The three major inputs of the community survey to the modal-split model are the definition of captive and choice ridership, the confirmation of "importance" weightings of travel time, cost, and convenience in the disutility equation, and the specification of service levels for transit network development producing travel times and costs. The modal-split flow chart (Fig. 6) indicates that total person trip tables are divided into 3 subtables on the basis of ridership: automobile captive, transit captive, and free choice. Automobile captive and transit captive are immediately assigned to their respective modes and are not subject to further modal split. Free choice is the only category to be subjected to disutility-based modal split. Free-choice transit trips are added to captive transit trips to get total transit tables; free-choice automobile trips are added to captive automobile trips to get total automobile trip tables. This procedure, which operates on each trip interchange (for work, shop, and other purposes), is described as follows:

1. A matrix of automobile-captive, transit-captive, and free-choice percentages by income group, system type, and trip purpose was defined by the attitude survey. For example, if 5 percent of the person trips are transit captive and 35 percent automobile captive, then overall transit trips can be no less than 5 percent and no greater than 65 percent. The trips that are neither transit captive nor automobile captive are considered free choice.
2. A disutility value Z of transit versus highways is computed for the particular trip interchange. This disutility value is computed from the following equation:

$$Z = 2.5\,(Ta + Tw - At) + (Tr - Ar) + \frac{(F - 0.5P - 5.7D)}{C}$$

where

Z = disutility of transit over highways in units of equivalent minutes,
Ta = walking time to and from transit,
Tw = waiting and transferring time associated with transit,
At = automobile terminal time at destination,
Tr = transit running time,
Ar = automobile running time,
F = transit fare,
P = parking cost at destination,
D = highway distance, and

Figure 4. Captive riders of door-to-door system by income stratification.

Figure 5. Captive riders of station/stop system by income stratification.

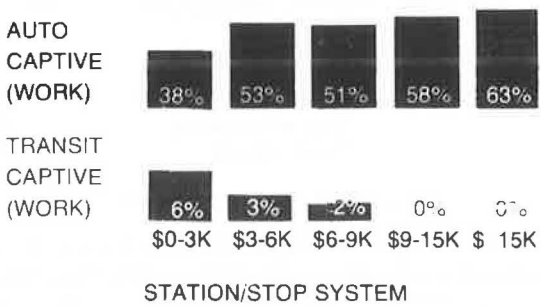
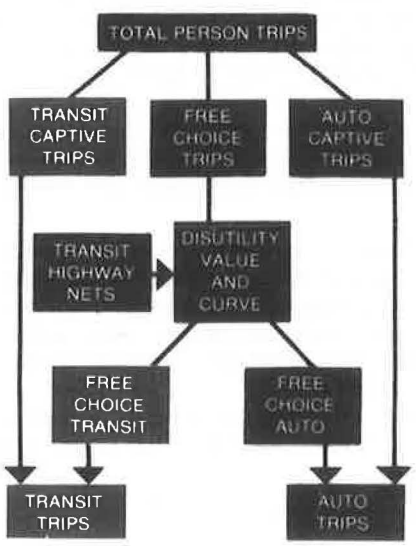


Figure 6. Modal-split model.



C = cost of 1 minute of time based on wage rate implied by median annual income of applicable zone of origin.

The attitude survey's responses to the service levels of waiting time, walking distance, and transit fare served as guides in the development of the transit network. This in turn yields the zone-to-zone excess and running time components and costs for input to the disutility equation. Furthermore, the weighting of 2.5:1:1 given to convenience, travel time, and cost respectively in the equation was confirmed by the results of the attitude survey importance rankings.

3. Once the disutility value Z has been computed, the percentage of free-choice riders that will use transit is read off the S-shaped disutility curve (originally calibrated in the Minneapolis-St. Paul metropolitan area). This percentage is applied to free-choice transit riders. The remainder of free-choice trips is defined as automobile trips.

4. Total transit patronage thus consists of transit captives plus some fraction of the free-choice travelers. Automobile trips consist of automobile captives plus the remaining fraction of free-choice travelers.

The entire procedure described above has been programmed as a FORTRAN subroutine to be inserted into the UMODE program of the UMTA Transit Planning Package.

SUMMARY

The community attitude survey served to confirm the basic assumptions of the disutility modal-split model and provided the captive rider endpoints, customizing the model for application to the Orlando urban area. The service level responses and profile of the sample aided the preliminary definition of characteristics of the regional transit network. A secondary but very important function of the attitude survey was to begin community orientation toward planning and acceptance of a future regional public transit system.

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