

previously was found by using the following equation: relative error = S'_x/VMT where S'_x = variance of group in question. Once the relative errors are calculated for each group, a comparison of results versus initial estimates used for sample-size calculations can be made. For sequential VMT estimates, the actual relative error can be used in sample-size calculations. Table 5 compares initial estimates and final calculated relative error, both at a 68 percent confidence interval.

COMPARISON OF PROJECT VMT WITH CURRENT VMT ESTIMATES

The current method of VMT calculation used by FDOT is summarized here. VMT of the county level is found for state highway (including federal route) systems only. Total VMT--that is, VMT for all facility types--is found for the entire state by use of gasoline consumption data. VMT by county (i.e., state highway system) is found by applying traffic counts to the length of highway section from which they were taken to arrive at VMT for the sample link.

The current estimate of VMT for the study area on state highway streets is 3 634 400 VMT/day. Without a precedent of local and county system VMT, a comparison between FDOT's current method and the GUTVC method was difficult to make for the entire street and highway system. However, a comparison was made by using data collected during the study on state system streets and calculating state system VMT by using the method tested as opposed to FDOT's current figure. The VMT calculated by the GUTVC's method for state system streets was 3 694 856. FDOT's estimate was 3 634 400, as noted above. The difference between the two methods is relatively small.

CONCLUSION

Although the comparison between VMT calculated by methods presented in the GUTVC and FDOT's existing VMT estimation program is good, the high relative errors calculated in this case study point out some deficiencies in the application of the GUTVC's

techniques. The use of correct and complete base data for sample-size calculations would do the most to reduce relative error. FDOT feels that a completed local street network would result in more accurate local street VMT estimates. It is obvious that the number of local street links sampled should be increased. The error in the link file on which freeway and arterial links were developed could have caused some of the variance and relative error experienced. The possible error in link lengths was discovered during FDOT's Brevard County Transportation Planning Update.

In order to reduce the costs of data collection, a data base should be developed in which historical data can be kept for future use. By creating a traffic-count data file, data can be used for more than VMT uses and reduce the amount of data collection necessary. This will not work in reverse because special counts do not supply the variety of facility-type data needed. FDOT also found that, by sectoring the study area geographically, travel costs were reduced substantially, accuracy in VMT estimates was not badly affected, and a useful form of VMT data was created.

Although the possibility of error in both sample-size calculation and data collection does exist, the comparison between the GUTVC's estimate and FDOT's estimate is relatively good. The GUTVC method provides a general breakdown of VMT by area and facility type--something not currently available by FDOT's method--and flexibility in the choice of area size from which one may select a sample.

ACKNOWLEDGMENT

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Small-Scale, Ongoing Home-Interview Survey in Pennsylvania

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This paper reports on the design, administrative aspects, and selected findings of the Southwestern Pennsylvania Regional Planning Commission's (SPRPC's) small-scale, ongoing home-interview survey implemented in the agency's six-county region surrounding Pittsburgh. As initially conceived, the survey was an ambitious effort with multiple objectives. The implemented survey was a modest effort with a single, surveillance-related objective: to measure key travel characteristics and to compare and isolate changes in the characteristics over time. Achievement of the objective would reestablish and serve to retain the credibility of SPRPC's transportation data base. As the objectives were revised over a two-year period, so, too, was the sample size. The final sample design, based on satisfying the surveillance objective still remaining within acceptable funding limits, involved a total of 1600 household interviews during 1978--with an additional 1600 scheduled for interviews during the 1979-1980 period. Guide-Post Research, Inc., a market research consultant employing experienced interviewers, performed the data collection. However, SPRPC maintained overall survey control--managing the effort from data collection through pro-

cessing. The consultant achieved an interview completion rate of 91.1 percent for the first year of data collection. Selected data tabulations from the 1978 portion of the survey are also presented as an example of the information available and its accuracy. The tabulations indicated that no unusual travel activity occurred in the region during 1978.

On April 10, 1978, 18 households in the six-county area of the Southwestern Pennsylvania Regional Planning Commission (SPRPC) were personally contacted. The household members were interviewed to obtain transportation-related data. The 18 households were the first interviewed as part of SPRPC's ongoing home-interview survey--scheduled through 1980.

This paper reports on the evolution of SPRPC's

home-interview survey. The survey was intended to show the transportation data needs of SPRPC, how the survey was shaped to satisfy these needs, and what management aspects were involved in a small-scale travel survey. This paper also presents selected tabulations from the first year (1978) of data collection. The tabulations are not given for a detailed discussion of the findings but rather as an example of the type of information available and the accuracy associated with such information.

EVOLUTION OF SURVEY

As conceived in early 1976, a home-interview survey was viewed as a means of achieving four major objectives: (a) to reestablish the credibility of SPRPC's transportation data base by the surveillance of travel and related characteristics; (b) to obtain data required to retain a long-range transportation planning capability; (c) to obtain data needed in carrying out a planning process oriented toward shorter-term project planning; and (d) to obtain data needed to satisfy (anticipated) federal requirements for reporting transportation indicators.

Surveillance Objective

In 1976, SPRPC was confronted with problems probably experienced by other agencies that had not conducted a major transportation data-collection survey for a decade. (SPRPC's major origin-destination survey was conducted in 1967.) That is, the commission's transportation data base was dated and its credibility, consequently, questioned. A home-interview survey was viewed as the means of reestablishing the credibility of the data base. A current bank of travel information, in turn, would support decisions by the commission members. It was also felt that agency credibility would be enhanced by exhibiting, by means of newsletters and press releases, a constant awareness of travel activity.

Because major use of the data would be by governmental jurisdictions represented on the commission--i.e., the city of Pittsburgh and the six counties--data would be collected for these areas. Monitoring travel activity to isolate changes, a task that would retain credibility, led to an ongoing survey approach.

Planning Objective

Since the transportation data base was dated, the validity of the travel demand forecasts, made by using models developed from the 1967 survey data, was questionable, as was the long-range transportation plan that was developed and evaluated by means of the demand forecasts.

A survey involving personal interviews of household members would obtain data needed to evaluate and update the travel-forecasting models. Ultimately, that task would lead to the reevaluation of the long-range plan.

Because of (a) severe funding restraints, (b) the increasing need for resolving structural deficiencies of the existing transportation system and (c) the uncertainties associated with implementing elements of a long-range plan, the transportation-planning process at SPRPC was becoming short-range oriented in 1976. With emphasis on a process becoming so altered, the need arose to develop transportation models capable of assessing specific project impacts within subareas of travel corridors for shorter time periods than previously considered. Although viewed as a means of retaining a technically sound, long-range planning capability, a home-interview survey was also viewed as a way of

acquiring data necessary to develop models that could be used to address some of the issues within the short-range planning framework.

Reporting Requirements Objective

In 1975, the Transportation Research Board established the Advisory Committee on Urban Transportation Data-Reporting Needs and Requirements. The purpose of the committee was "to provide assistance to the Urban Mass Transportation Administration and the Federal Highway Administration in developing a national urban transportation-reporting system" (1).

The exact nature of the data to be included in the national system was unknown when the home-interview survey surfaced at SPRPC. However, what was known at that time was that vehicle miles of travel (VMT) would be an item included in the system. (SPRPC was aware of the evolving reporting system because a staff member served on the advisory committee.)

A home-interview survey was considered a sufficiently accurate means for obtaining data needed to estimate VMT. Specifically, a survey could be designed to collect adequate origin-destination data for zone-to-zone trip table development. Trips could then be assigned to the transportation network, and VMT calculated and summarized by the geographic areas and highway functional classes required for national reporting.

Initial Survey Design

To achieve the objectives for time-series data collection and to maintain financial feasibility, methodology developed by Wickstrom and Pisanski (2) was used in part in designing a continuing home-interview survey. The sample design was based on replacing data from the 20 000 households interviewed during 1967. It called for 5000 household interviews annually (about a 0.6 percent sample), which would have resulted in a completely new survey file and new trip tables after four years.

However, agencies expected to fund the survey (as part of the SPRPC Unified Planning Work Program) questioned the cost-effectiveness of the survey design, as well as its ability to fully satisfy the objectives. In general, the agencies did not consider the survey capable of obtaining data needed for addressing short-range transportation planning issues. (To retain economic feasibility, a less-than-detailed questionnaire was developed.) They also believed that VMT could be estimated with more accuracy by using volume data from a traffic-count program. They also felt a much smaller survey could satisfy the surveillance objective. Finally, because the survey could not be justified on the basis of the other three objectives, it could not be justified on the sole basis of the long-range planning objective--given the de-emphasis of that element of the transportation-planning process. However, the importance of time-series data collection to compare and isolate changes in travel characteristics was recognized--as was the importance of having a system of models that could be used to address issues confronted in short-range planning.

The concept of an ongoing home-interview survey was not categorically rejected. Rather, initial objectives and survey size were questioned. A less ambitious design was needed.

Redefined Objectives, Redesigning Survey

The home-interview survey design was revised in accord with the redefined objectives. It now reflected the data needs of a modeling system

Table 1. Home-interview survey sample design.

Geographic Area	Household Interviews		
	1978 (Full Sample)	1979 (One-Half Sample)	1980 (One-Half Sample)
City of Pittsburgh	200	100	100
Allegheny County (exclud- ing Pittsburgh)	400	200	200
Armstrong County	200	100	100
Beaver County	200	100	100
Butler County	200	100	100
Washington County	200	100	100
Westmoreland County	200	100	100
Regional total	1600	800	800

responsive to short-range planning issues and of a monitoring program for time-series comparisons of travel characteristics. There was no major long-range planning objective nor a survey objective to satisfy requirements of the national reporting system. [VMT would be obtained from a traffic-count program based on a link-sampling procedure (3).]

Modeling needs for short-range planning hinged on an individual-choice mode-split model. A detailed questionnaire was developed to obtain data for model development (i.e., disaggregate data set).

Based on the interviewing level thought to be financially justifiable to the funding agencies, the sample was reduced to 1000 households per year throughout the six-county region. However, the agencies believed the revised design could not satisfy the monitoring objective (because the regional household distribution was the sampling basis, the monitoring function would suffer in the low-populated counties). The questionnaire developed to collect a disaggregate data set was judged far too lengthy and, therefore, too costly.

Final Objective and Survey Design

The major result of discussions on the redesigned survey was agreement that the county-level monitoring function was the prime survey objective. The collection of a disaggregate data set was deemed a secondary objective and, in a later mutual decision, excluded entirely from consideration during the final design effort.

The survey sample was designed by using standard statistical methods, tempered by a realization of available funding for this type of data-collection effort. Specifically, the ongoing aspect of the survey (a feature based on the policy decision intended to reestablish and then retain the credibility of SPRPC's transportation data) required that the survey be annually budgeted in the agency's Unified Planning Work Program. With other planning activities (such as transportation systems management) competing at increasing rates for limited planning funds, it was recognized that the survey cost should be kept sufficiently low to ensure continued funding through 1980.

Remaining cognizant of the cost issue, the final sample design task was initiated by generating a list of the key travel characteristics to be measured and monitored for each county and Pittsburgh. Of the items on the list, person trips per household was considered the most important to monitor. However, it was recognized that annual detection of changes in this item at the county level would require excess precision and, therefore, too large a sample, too costly a survey. Consequently, 10 percent accuracy (with 90 percent confidence) was accepted for estimating person-trip

rates. The resulting sample design was 200 households per county and Pittsburgh.

To further reduce the overall sample size and because it was unlikely that more than 10 percent annual change in person-trip rates would occur in the counties, a decision was made to monitor biennially at the county level after first measuring the travel characteristics during 1978. That is, a full sample of households would be interviewed during 1978, while one-half of the sample would be interviewed during 1979 and the remaining one-half during 1980. Though county comparisons would be made on a biennial basis, sufficient accuracy was expected for annual regional comparisons.

The final sample design and interview schedule appear on Table 1. Note that Allegheny County (excluding Pittsburgh) has double the sample of other areas because an attempt was made to obtain better accuracy for estimating transit-related items (most transit service is available in Allegheny County). The decision to biennially monitor at the county level allowed Allegheny County's sample to be doubled. Based on an annual average, the total three-year sample was close to the 1000 interviews/year generally thought to be financially acceptable.

Although cost was a major issue throughout the survey design period, no budgetary problems materialized. In fact, annual total survey costs have represented less than 4 percent of the agency's total work program budget. Total survey costs have averaged about \$66 000/year.

PREFIELD WORK

Questionnaire Design

A questionnaire was developed to obtain data needed to estimate selected travel and related characteristics. It was pretested and, based on the results, slightly revised. The questionnaire was also evaluated following the spring 1978 season of interviews. However, no modifications were made because no questions were reported misunderstood by the respondents.

The data items collected are listed below:

1. Household information--residents in household; out-of-region visitors; value of structure (if owned); monthly rent (if rented); age of structure; vehicles available by type, make, model, and year; household gross income; and persons contributing to household's gross income;
2. Person information (recorded for each person five years of age or older)--relation to household head; sex and age; automobile-driving status; occupation status; physical, mental, or other health conditions that (a) limit kind or amount of work, (b) prevent person from working, (c) limit or prevent use of transit, or (d) limit or prevent driving a car;
3. Work place and occupation information (recorded for all workers)--job status (full or part time), occupation, name and type of business, street address of work place; and
4. Trip data (recorded for each person five years of age or older)--trip purpose, trip-end location, mode of travel, vehicles used (if household vehicle), persons in vehicle, time of trip (start time and duration), captive or choice automobile user (work trips only), type and cost of parking (automobile-driver work trips only), captive or choice transit user, and blocks walked to and from transit stop.

Sample Selection

The total 3200 samples for the home-interview survey were random--systematically selected based on the housing distribution within each county. By using SPRPC's street series maps, home-interview samples were plotted on locational maps for use by interviewers. A list of sample addresses was also prepared for the interviewers and for overall survey control by SPRPC staff.

Consultant Selection

Throughout the survey design period, there was some question concerning who would perform the interviewing of the selected households. SPRPC advocated the use of a consultant with personnel experienced in interviewing; other agencies believed that, since the survey was ongoing, SPRPC should hire and train additional staff. When not interviewing, additional staff members were to be used for processing survey data.

After much discussion, all agencies agreed to the use of a consultant. SPRPC already had sufficient staff members for processing work; hiring additional personnel for the single purpose of interviewing would not justify the cost. The consultant selected to perform the interviewing was Guide-Post Research, Inc.--a Pittsburgh-based market research firm.

Although the selected consultant used experienced interviewers, the unique aspects of a travel survey involving origin-and-destination questions required additional training. The week before interviewing, the consultant's personnel assigned to the survey participated in an intensive three-day training session conducted by SPRPC staff members who managed the 1967 origin-destination travel survey. Additional training sessions were scheduled prior to each season of interviewing.

FIELD WORK

Personnel assigned to the field-work phase of the survey included a survey field supervisor, six interviewers, a quality-control clerk, and the director of survey operations.

The survey field supervisor was responsible for scheduling and assigning all work. The supervisor also assisted in follow-up interviews and carried out the preliminary editing of survey returns.

Interviewers were responsible for collecting data by talking personally, when practical, with each household member 16 years of age or older in accordance with interviewing procedures detailed in the procedures manual (4). Trip data for members younger than 16, but older than 5 years, were obtained from a responsible household member--usually the household head.

Interviewers worked a Tuesday-to-Sunday schedule and made their initial contact with the household either the day before or the day after the designated travel day (only weekdays were considered travel days; no weekend data were obtained). Contact before the travel day was made to explain the survey and distribute trip diaries to household members. The diaries were to be used by participants for recording their trips on the travel day; the interview would be conducted the next day.

The alternative to pre-travel-day contact was the cold-call method. This method simply involved contacting the household the day after the designated travel day and conducting the personal interview then.

Agencies funding the survey suggested that a test be made to determine which of the two contact approaches would yield better results in the form of

both household cooperation and accurate responses. Consequently, both approaches were tested during the survey's first week. Results indicated that better cooperation was gained from households in rural areas by using the pre-travel-day approach. In urban areas, the cold-call method resulted in better cooperation. As far as data quality was concerned, however, no difference was detected between the two approaches. Nonetheless, to maximize the number of cooperative households, the cold-call approach was used exclusively in urban areas, while pre-travel-day contact was made only in rural areas for the remainder of the survey.

The quality-control clerk was housed in the survey office and received completed questionnaires from the field supervisor two or three times a week. Duties of this clerk included editing each returned survey questionnaire and conducting respondent callbacks as part of the quality-control procedure. Fifteen percent of the households were randomly selected and phoned for data-verification purposes.

The director of survey operations monitored survey progress and held meetings with all field personnel when necessary to correct procedural difficulties. The director also acted as liaison between the survey office and the SPRPC central office to ensure smooth operation and flow of completed interviews.

CENTRAL OFFICE WORK

The SPRPC central office staff consisted of two editor-coding clerks, a survey supervisor, and the manager of data services.

The editor-coding clerks carried out complete edits of the survey forms. They also reviewed self-coding item and coded selected data fields. Items requiring coding included worker occupations, trip-end and employment-site geographic locations (respondents were provided maps to help locate trip destinations; in most cases, including rural areas, the maps were not used), and land use activity.

The survey supervisor conducted all SPRPC quality-control callbacks; these were in addition to the 15 percent performed by the consultant. SPRPC's quality-control procedure involved callbacks to 25 percent of the households (later reduced to 15 percent as interviewer proficiency increased). Households were randomly selected; none failed the quality-control test. Any that would have failed would have been reinterviewed at the consultant's expense, as the contract with the consultant stipulated.

The manager of data services coordinated all survey functions, developed procedures, and interpreted survey policy. The interface of manual and computer operations was also the manager's responsibility.

SURVEY RESULTS: SELECTED FINDINGS FOR 1978

Although concern was expressed over the use of a consultant for data-collection purposes, this decision proved a wise one. The consultant carried out all duties assigned by SPRPC in a professional manner and satisfactorily completed the field work within the specified budget (\$22.30/interview in 1978), quality standards, and time limitations. The overall noninterview rate of 8.9 percent and low refusal rate of 1.9 percent evinced a definite dedication to the survey by the consultant's field personnel.

Information obtained from the 1458 households with completed interviews was processed and formed the basis for analysis. As mentioned, only selected findings are reported and briefly discussed. These

are offered to illustrate some data tabulations developed by using the survey information and also to show the accuracy of the findings.

Person Trips per Household

Household trip rates on an average weekday in 1978 are listed on Table 2. The rates were developed by using unlinked trip data.

The design accuracy (relative error) for estimating household trip rates was ± 10 percent (90 percent confidence). The achieved accuracy, however, was slightly less--approximately 11 percent for all counties, except Allegheny and the city of Pittsburgh. Accuracy for these areas was calculated at 8 and 12.7 percent, respectively. Larger-than-expected data variability contributed to wider error ranges for rates calculated by county, although the ranges were acceptable. A ± 5 percent relative error was calculated for the regional household trip-rate estimate.

Based on the calculated errors, the city of Pittsburgh's household trip rate was found to be significantly lower than rates for the other areas.

The major reasons were lower income (1977 median household income in the city was \$9600, compared with a regional median of \$13 100) and fewer automobiles available to city households.

With only one exception, there was no significant difference among the trip rates for the six counties. The exception was Armstrong County. This county's rate of 5.91 was significantly lower than the Beaver County rate of 7.52 per household. In this case, however, the major factors influencing household trip productions were similar for the counties. (The trip rates of these counties will be given special attention as the survey continues.)

Finally, the 1978 regional average household trip rate of 5.95 was not significantly less than the trip rate of 6.20 calculated by using SPRPC's 1967 home-interview survey data.

Automobiles per Household

The number of automobiles available for personal use by household members on an average weekday in 1978 also appears in Table 2. Relative errors for this item were 12.7 percent for the city, 5.5 percent for Allegheny County, between 7 and 8 percent for the remaining counties, and 3.4 percent for the region.

As expected, Pittsburgh households had the lowest number of automobiles available. Availability in all other areas was similar, with Washington County the exception. Households in this county had significantly more automobiles than Pittsburgh households, but significantly fewer than the other counties. Slightly lower income levels in Washington County explained the difference.

The 1978 regional average of 1.41 automobiles available was significantly higher than the 1.1 value calculated in 1967. Additional analysis of the survey data revealed that the increase in automobiles per household was not due so much to households purchasing and obtaining a first car as it was to their acquisition of a second and third, as illustrated by Table 3 (5,6). [Table 3 was developed for the Pittsburgh standard metropolitan statistical area (SMSA) for comparison purposes. The Pittsburgh SMSA includes Allegheny, Beaver, Washington, and Westmoreland Counties.]

Mode of Travel

Mode distribution for all trip purposes is reported in Table 4. It indicates that travel for all purposes was overwhelmingly by automobile. Except

for the city, mode distribution also was essentially constant among the counties (values in Table 4 are generally subject to a 0.3 percent error, although the error is about 0.2 percent for Allegheny County and about 0.1 percent for the regional values). At the regional level, a slight decrease in transit use was experienced since 1967. The higher use of other modes in 1978 was attributable to a larger share of school trips on school buses since 1967.

Table 5 lists mode-use percentage (subject to a 0.3-0.4 percent error) for work trips by four household income groups. The low-income group contained the greatest percentage of transit users and carpoolers and the smallest percentage of people who drive to work alone. As household income increases, there appears a jump in the drive-alone mode from the low-income group to the \$8000-\$14 999 group, after which the drive-alone mode percentages leveled off.

As the sudden increase occurred for the drive-alone mode, so, too, did a sudden decrease in transit occur for the low-income group. The percentage of transit use was similar for the \$8000-\$14 999, \$15 000-\$24 999, and \$25 000 or more income groups, following the sharp decline from almost 19 percent use by individuals in the low-income group.

Although changes in the percentage of carpoolers occurred among the income groups, this mode is equally used on a percentage basis by all income groups.

Trip Purpose

The trip-purpose distribution by county is offered in Table 6. The values are subject to a 0.2 percent error for Allegheny County, 0.1 percent for the regional values, and 0.3 percent for the remaining values.

There was no significant difference among the trip-purpose percentages across geographic areas, nor was a significant difference detected between the 1978 regional distribution and the distribution based on 1967 survey data.

SUMMARY AND CONCLUSIONS

The initial home-interview survey concept was a fairly ambitious effort to obtain data needed for various transportation-planning activities at SPRPC. The survey implemented was a small-scale, ongoing effort with a surveillance-related objective; the initial concept was molded by multiagency input over a two-year period.

From an administrative viewpoint, the survey has proved successful. The small sample survey, requiring only a limited number of personnel, was easily managed. Also, deadlines were met without exception, no cost overruns were experienced, data quality was monitored and maintained, and data processing was performed quickly and efficiently.

From the standpoint of accuracy of results, the survey can also be considered successful because achieved accuracy for the key travel characteristic--household trip rates--was close to that used for designing the sample.

Has the survey achieved its prime objective? Data collected during 1978 have been compiled for the major governmental units of the region, compared with available 1967 data, and readied for comparisons with 1979 and 1980 data. In this respect, the survey has satisfied the surveillance objective. However, the value of surveillance is found in its ability to serve decision-making functions. By itself, surveillance is a wasteful activity (2). Information from the survey is

Table 2. Person trips and automobiles per household in 1978.

Geographic Area	Person Trips per Household	Automobiles per Household
City of Pittsburgh	4.08	0.87
Allegheny County (excluding Pittsburgh)	6.26	1.53
Armstrong County	5.91	1.58
Beaver County	7.52	1.63
Butler County	6.43	1.65
Washington County	6.22	1.40
Westmoreland County	6.45	1.58
Regional average	5.95	1.41
Regional average in 1967	6.20	1.10

Table 3. Household automobile ownership distribution for Pittsburgh SMSA.

Year	Percentage Distribution		
	No Automobile	One Automobile	Two or More Automobiles
1978	19.0	38.8	42.2
1974 (5)	19.5	48.2	32.3
1970 (6)	20.5	51.3	28.2

Table 4. Percentage of 1978 person trips by mode of travel.

Geographic Area	Automobile Driver	Automobile Passenger	Transit	Other ^a
City of Pittsburgh	49.0	26.0	22.3	2.7
Allegheny County (excluding Pittsburgh)	58.2	24.5	4.3	13.0
Armstrong County	61.9	22.6	—	15.5
Beaver County	65.4	21.1	—	13.5
Butler County	58.4	24.1	—	17.5
Washington County	59.2	24.1	—	16.7
Westmoreland County	63.0	22.4	—	14.6
Regional average	58.7	23.9	5.3	12.1
Regional average in 1967	56.5	26.5	7.5	9.6

^aIncludes transit for all areas except Pittsburgh and the balance of Allegheny County.

available for use by the regional decision makers and has been used in reports to this body. Because no unusual travel activities were detected during 1978, the degree to which the survey data have affected transportation decisions cannot be assessed—except to say that current data must surely have eased credibility problems associated with using dated information.

Some survey data (coupled with secondary source information) has been used in developing a travel demand-forecasting system responsive to short-range planning issues (while also providing the capability to make a longer-range forecast). To the extent that the survey data have been used in the demand-forecasting process, they have also served the decision-making function.

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Table 5. Percentage of 1978 mode distribution for work trips by household income (1977 dollars).

Mode	Household Income (\$)			
	0-7999	8000-14 999	15 000-24 999	25 000 or More
Drive alone	53.6	72.9	72.4	69.3
Carpool	27.5	21.4	17.7	22.7
Transit	18.9	5.7	9.6	7.4
Other	—	—	0.3	0.6

Table 6. Percentage of 1978 trip-purpose distribution.

Geographic Area	Home	Work	Shop	School	Other
City of Pittsburgh	43.4	18.0	10.9	5.2	22.5
Allegheny County (excluding Pittsburgh)	43.6	14.9	11.1	8.6	21.8
Armstrong County	43.3	15.8	11.9	8.7	20.3
Beaver County	42.5	13.2	10.7	8.2	25.4
Butler County	44.3	14.1	11.6	10.3	19.7
Washington County	40.5	14.7	8.8	9.6	26.4
Westmoreland County	43.6	17.2	10.0	8.7	20.5
Regional average	43.2	15.5	10.7	8.3	22.3
Regional average in 1967	41.3	17.0	12.3	7.7	21.7

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