Successful Administration of a Mailed 24-Hour Travel Diary: A Case Study

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ABSTRACT

Recent transportation survey research has shown that successful travel diaries can be constructed, and that these diaries can collect information on travel by individuals for a period of 24 hr or more. The successful diaries are comparatively expensive survey instruments and have been described primarily in terms of use in conjunction with a personal visit by an interviewer. The interviewer may collect some information at the time of the visit, but he plays an essential role in explaining the use of the diary. This interviewer visit has made the diary an expensive survey instrument. A case study of the administration of a travel diary survey conducted through a combination of telephone contact and mail-out, mail-back procedures is described. In the description of this case study it is shown that the diary can be administered successfully by this means, that the results obtained are of a high quality, and that a response rate significantly higher than that associated with most mail surveys can be obtained. A number of details of the administration methods used, which are believed to have contributed to the success of the instrument, are discussed. The procedure described produced a usable response rate of 58.5 percent of the mail sample of households, from which it was possible subsequently to calibrate new trip-generation and modal-split models. Some of the results obtained, including the higher trip rates for non-home-based trips, are described. It is suggested that refinements to the instrument and procedures could generate yet higher response rates.

Several papers have appeared recently extolling the virtues of a travel diary for use in collecting a 24-hr record of household members' travel (1-4). These travel diaries provide a means to have individuals record details about their travel and activities for a day in the future, rather than relying on recall. Brog et al. (1) and Stopher and Sheskin (2) claim that the data obtained are more complete than the data collected by the traditional recall surveys used for the past three decades in transportation planning activities. However, most transportation surveys that use the diary have made use of a face-to-face encounter between a survey person and one or more members of the household to administer the travel diaries (5).

Because of the need for careful design of the diary (i.e., the use of various devices such as color-keying, indented cuts, and special bindings), the diary is a comparatively expensive survey instrument. In versions that these authors have used in the United States, costs have varied between about $0.75 and $1.25 per diary. Given an average requirement of more than three diaries per household, the instrument alone can cost between $2.25 and $4.00 per household. In addition, many of the diaries will be returned spoiled or empty but unusable, or just not returned, thus increasing the cost per household for completed, usable diaries. It is a conservative estimate that the instrument cost alone for each completed household is approximately $10. If this cost is added to the cost of the labor-intensive activity of sending out survey personnel to deliver and explain the use of the diaries, and possibly also to retrieve completed diaries, the survey unit costs increase considerably. In a 1980 survey of this type in Michigan, Stopher and Sheskin (2) estimated the total per household cost (including data reduction) at approximately $125.

There has been a slow acceptance of the diary for urban area data collection. Some early efforts reported low response rates, which may have been a contributory factor to this slow acceptance. The cost of the diary procedure may also have much to do with this. However, the estimated travel-diary survey costs in excess of $100 must be set in the context of the cost of conventional home-interview surveys that cost anywhere from about $80 to more than $500 per household, depending on design, length of interview, response rates, and many other factors. Furthermore, more efficient sampling methods other than simple random sampling have been applied successfully, thereby increasing the efficiency of the survey personnel. Recent research (6,7) has indicated that large samples, on the order of 2 percent or more of regional households, are quite unnecessary for urban area updates; and that samples of considerably less than 5,000 households produce data of more than sufficient accuracy for virtually every transportation planning need. These characteristics have made the diary a practicable instrument, even at a cost of more than $100 per household. However, it is clear that, if the cost can be reduced, the procedure becomes more accessible to many urban areas and may offer a relatively low-cost method to update decades-old data or collect data needed for new types of models and forecasting procedures.

In this paper the use of the 24-hr travel diary is described. The diary used a combination of telephone and mail contacts that produced a high response rate, appears to have generated data that may be more complete than that obtained from more conventional methods, and that cost substantially less than $50 per completed household. The telephone contact provided an extremely effective means of random sampling, without the need to seek out and correct some form of household sampling frame.

As is usual in a survey effort of this nature, the procedures evolved as the survey proceeded. Rather than a chronology of developments of the technique, the procedure is described in the form in which it was administered. A detailed and extensive pilot survey was conducted but is not described herein. Without this pilot survey, many of the successful elements of the final design would not have been developed and implemented. Not all elements were tested in the pilot survey, but those that were not tested were introduced into the main survey to

correct problems encountered in the pilot survey. In this respect, the pilot survey was not only indispensable to a good final survey, but succeeded in all of the primary areas that pilot surveys are designed to handle (8). One detraction from the case study is that the survey was not designed as a comparative exercise among alternative methods or instruments. Therefore, the success of the instrument and its administration must be based primarily on response rates, nonresponse biases, and measures of the quality of the data obtained.

DESIGN

Sample

The sample was designed to be selected in a two-phase process. The first phase was a simple random sample of telephone numbers generated by random-digit dialing. From the households contacted by telephone, the second-phase sample was selected on the basis of household size and automobile availability. Before the survey, certain combinations of these two variables were identified that should have encompassed more than 75 percent of households and more than 80 percent of daily regional trip making. The households contacted in the second-phase sample were asked to complete travel diaries.

Survey Instruments

The first-phase sample was given a 5-min telephone interview that established household size, automobile availability and ownership, number of workers in the household, number of adults, type of housing, and numbers of trips made by bus and car for each of work and nonwork purposes by the contacted respondent on the survey day. During the telephone interview the interviewer identified whether the household was eligible for the diary survey. (This was done by giving each interviewer a laminated selection grid that showed household size and automobile ownership. The interviewer first placed a penny on the column heading for the household size, and then moved the penny down the column to the appropriate value of the automobile availability. If the cell had an X in it, the household was not selected for the travel-diary survey; otherwise, it was.) If the household was eligible, the interviewer described the diary survey briefly and requested the address to which to send the diary materials. The contacted respondent was informed of the day to be used to complete the diaries.

The second-phase sample received a mail package that contained several items. First, there were the correct number of travel diaries (for all members of the household who were at least 5 years old), on the outside of each of which a sticker was attached indicating the day of the week on which the diary was to be filled out. The travel diary included not only a diary section as described by Stopher and Sheskin (2), but it also included a small booklet requesting details about the respondent (age, gender, relationship to other household members, education, driver's license status, and so forth) and details about one of the trips selected from the diary. These details included travel time components and cost for the trip selected, and equivalent data on up to two alternative travel modes for making that trip.

In addition to the diary, there was a one-page survey form asking for certain characteristics of the household. These details included the same vehicle availability and ownership questions used in the telephone survey, parking availability and cost at home, military or civilian status (because of the large number of military households on Oahu), household size, and income. The package also contained two signs indicating the travel-diary day, an envelope for collecting together and returning the survey forms (preaddressed and printed with a reply-paid postage license), and a cover letter from the director of the metropolitan planning organization (MPO) indicating the purpose of the survey, the importance of the household's response, and a telephone number to use for questions about the survey.

The entire package was mailed out in a large white envelope. Computer-generated address labels were fixed to the envelopes, using the contacted respondent's name, if given to the telephone interviewer. Postage stamps rather than metered or prepaid bulk mail were used for mailing, and these stamps included some attractive commemorative stamps (9).

Contact Procedure

Households were contacted initially by telephone, and those households that were eligible were then mailed a package of survey materials, as described in the preceding section. The travel-diary day was set as the same day of the week as the day of the telephone contact, but 1 week later. This was done in the belief that it would help respondents remember the day more easily, and because it would be less complicated for the telephone interviewers. The only exception to this procedure was for telephone interviews made on Saturday (no calling was done on Sundays). The interest was to obtain travel data from weekdays, so that Saturday interviews set the diary for the Wednesday or Thursday (10 to 11 days) following the telephone interview. (Use of the Wednesday or Thursday immediately following would not have provided sufficient time for the mail packages to arrive.)

A telephone follow-up was used with all households, based on a computer listing of the names, addresses, and telephone numbers for each travel-diary day. This contact was made on the evening before a household's travel-diary day by using specially trained interviewers. The purposes of this contact were to remind households of the agreed-on travel-diary day, to make sure that the survey package had been received and opened, and to answer any questions about the survey. In the few instances where a package had not been received, the address was verified and another package mailed with the request that the travel-diary day be the same weekday 1 week later. If the package had been received but not opened, the person called was asked to get the package and open it, and the interviewer explained what was in the package and how to use each item.

If a mail package had not been returned by 4 days after the travel-diary day, a reminder postcard was sent, urging completion on the same weekday of the week in which the reminder was received. Further follow-ups had been planned but were not executed because the response rate already achieved by these prior methods exceeded the clients' expectations and requirements. A limited follow-up and targeted remailing was undertaken and is described later in the paper. A "thank-you" letter and a copy of the State Highway Map were sent to all households that returned completed packages.

Logistics

The success of a multiple-contact survey of this type resides largely in an effective logistical

design. The idea behind this is to make each respondent believe that his or her response to the survey is so important that the survey administration knows on precisely which day he or she is to complete travel diaries and knows whether the survey has been completed and returned.

The procedure for mailing out survey forms included a series of steps of checking, computerizing, packaging, and dispatching the forms. It is most easily described by considering a specific day's telephone interviews, that is, the first Wednesday. Telephone interviews were undertaken on Wednesday evening and were completed by about 8:30 p.m. On Thursday morning all telephone interviews, still in individual interviewer binders, were checked visually for completeness, correct designations of the household by cell of the trip-generation matrix, readability of the address, and correct identification of mail-out status. Specific errors were noted and the interviewer was informed of these and instructed on correcting problems before the start of the evening's interviewing. During checking, the interviews were tabulated by household size and vehicle availability categories to determine the distribution of surveys obtained and particularly to determine where terminations were occurring. This lead, for example, to discovery that the early days of the survey were experiencing an exceptionally high termination rate for one-person households. After sensitizing interviewers to this issue, the response of these households improved dramatically.

After checking, the eligible interviews were sorted by number of travel diaries to be sent out for the mail-out surveys, followed by ineligible households, and finally by terminations that were complete enough to keypunch. In this order, the interviews were then sequenced-numbered by using a numbering system beginning at 110001, where the first two digits designated the main interview survey. Each new day's interviewing began at the next hundred. Thus Wednesday, October 21 had interviews numbered 110001 through 110111. Thursday, October 22 then commenced at 110201. A log was maintained showing the beginning and ending number for each day and the assigned logging day and date for each.

The sequence-numbered forms were turned over to the keypuncher who completed a second visual check, looking specifically for problems likely to be encountered in the direct keypunching process. Usually this check was carried out in the late afternoon, after the interviewers reported for the evening's interviewing, so that any questions could be directed to the responsible interviewer. The complete answer set to the telephone interview was keypunched during the evening, checked for errors, and both a recontact listing and a set of address labels were generated.

For Wednesday evening's interviewing, the keypunching was completed on Thursday evening and address labels were available by Friday morning. The address labels included the sequence number of the household, the number of travel diaries to be mailed, and the diary day. On the morning that the address labels became available, the mail-out packages were assembled. This assembly included stamping the household number on each of the travel diaries, on the household-interview form, and on the return envelope. The package was made up for each household and mailed at a U.S. postal facility providing next-day delivery service. Thus Wednesday's interviews were processed and mail surveys were sent by Friday afternoon, with delivery probably occurring on Saturday and Monday. With the travel-diary day being the following Wednesday, most households would receive their survey packages about 3 days before the diary day. This procedure was followed throughout the survey period, except that interviews from Saturday were delayed by 1 day beyond this schedule.

The telephone recontacts were set up by using the computer listing produced when the telephone interview was keypunched, as noted earlier. The household sequence numbers were transferred to the recontact interview sheets for each evening's calls. The procedure was to work straight through the households in sequence order, making one attempt at each number. If the household was contacted successfully, the number was checked off on the computer listing, and the answer spaces were filled out on the recontact form. When one pass through the list was completed, the interviewers returned to the beginning of the list and reattempted each of the unsuccessful initial contacts. This procedure was repeated a third time during the evening, after which recontact was concluded. Requests for a later call back were accommodated if the call back was to be within the telephone-interviewing period, or only a short time beyond the end of it. In this way some 75 to 80 percent of all mail-out households were recontacted successfully on the evening of their travel-diary day.

The telephone recontact also represented a means of checking and verifying the computerized record of telephone numbers and addresses. Corrections were keypunched on the following evening and a dual set of labels produced from the corrected records, together with an extra mailing label for those cases where a remailing was to be done. The dual set of labels consisted of two consecutive labels for each household. The first had the word "card" printed at the top right and the second had the word "thanks" printed there. These were used to mail and control the subsequent follow-up.

As survey packages were received in the mail, each package was date-stamped, opened, and its contents examined. The travel diaries were opened to see if they had been filled out, and the number filled out was written on the outside of the return envelope in the space provided. The household survey form was checked to see if it was filled out, and the appropriate space was marked for this on the outside of the envelope. Returns were sorted into numerical order during this process, and the number of packages returned by day of original survey (indicated by the household number) was recorded. This provided a profile of the returns by time from the original interview, as discussed later in this paper.

For each survey day's responses, once the dual set of labels had been generated, a cross-check was made between returned packages and the labels. The labels showed both the household number and the number of travel diaries, while the return envelope now bore the number of returned, completed diaries. If missing diaries were detected by this check, this was marked on the envelope; and, in the event that not more than one diary was missing, a thank-you was sent to the household. If the survey package was processed before mailing of the reminder postcard, then the label marked "card" was crossed through and that marked "thanks" was used to send the thank-you package. If the package was too incomplete for a thank-you, both labels were crossed through.

On the day designated for postcard mailing, all the uncrossed "card" labels were used on reminder postcards. After the reminders were sent, "thanks" labels continued to be used to send out thank-you packages as complete returns were received, or were crossed through if an incomplete return was received. This procedure proved to be an effective way of keeping track of returns and reminders, and only a few errors (less than 10) were detected in which an incorrect thank-you or reminder was sent. (One

household sent back an incorrectly sent thank-you package, with a note to say that they had not completed the survey forms and did not intend to, and therefore felt they should return the thank-you package.)

RESULTS OF THE SURVEY

Telephone Survey

A total of 2,883 telephone interviews were conducted, including 247 interviews of households that qualified for mailing but refused to give a mailing address. These are included in the 313 terminations in Table 1, not in the successful interviews. The rate of 65.5 percent of ineligible numbers called for interview is considered relatively low. Past telephone surveys have shown this rate to range between 75 and 85 percent. The lower rate in this survey is considered to be due to the sampling in proportion to numbers assigned by prefix (exchange) and to exclusion of the numbers outside the minimum and maximum currently assigned within each prefix.

TABLE 1 Disposition of Telephone Calls Made

Disposition	Telephone Numbers Called	
	No.	Percent
Not in service	4,599	30.9
Business	863	5.8
Number changed to new listing[a]	380	2.6
No answer	2,773	18.7
Busy	1,060	7.1
Recorder[b]	64	0.4
Total ineligible	9,739	65.5
Terminated	313	2.1
Refused	1,364	9.2
Unsuccessful request for call back	562	3.8
Eligible nonresponses	2,239	15.1
Successful interviews	2,883	19.4
Total eligible	5,122	34.5

Note: Data are from Schimpeler-Corradino Associates.

[a]A telephone company recorded message indicating a new number assigned was considered equivalent to not-in-service status for numbers selected by the computer.

[b]A recorder was considered equivalent to no answer and tried again.

All interviewing was conducted in English, although there are many Oahu residents whose native language is not English. Translation problems and the expected difficulty of finding multilingual interviewers dictated a restriction to English. Of all telephone contacts, 191 households had language problems such that no telephone interview could be conducted. These are included in the terminated calls in Table 1. If answers could be obtained, but it was apparent that the household members would be unlikely to be able to deal with the written questionnaire, the interviewer was instructed to mark households otherwise eligible for a mailing as FLP (foreign language problem) and treat the household as ineligible. Only 5 such cases were encountered out of the 2,883 completed telephone interviews.

If the interviewer was unable to get a single question answered by the selected respondent, this was designated a refusal. The volume of refusals at 1,364, or 26.6 percent of eligible numbers, is considered high, but generally does not reflect on the skill of the interviewers. A call was considered to end in a termination if the interviewer succeeded in asking at least one question of the selected respondent and obtained an answer. The low rate of terminations, at 6.1 percent, is a reflection of the skill of the interviewer in obtaining responses once a respondent was contacted who could be persuaded to answer the first question. Furthermore, the number of respondents who terminated during the main questioning in this survey, as opposed to refusing to give an address for mailing, was only 66, or 1.3 percent. The unsuccessful requests for call back were those instances where contact was made with a household and the respondent requested a subsequent call back. Up to three attempts were made to recall the household, with each of these attempts being several days apart and with at least one on a weekday and one on a Saturday. Of these, 562 remained as failures to make a further contact by the end of the calling period.

Mail Survey

Of the 2,883 interviews conducted, 2,595 were with households eligible for a mail survey, 2,348 of which provided an address and were sent survey forms. A total of 1,485 mail forms were returned. The distribution of telephone and mail surveys by day of week is given in Table 2. The data show a fairly even distribution of survey effort by day of week, with only Thursday showing a significant drop below the other days, although this is compensated for in a higher eligibility rate and a higher response rate. Overall, about 90 percent of interviewed households qualified for the mail survey, and this varied from a low of 87.3 percent to a high of 92.6 percent. Of interviewed households, 81.4 percent were mailed surveys, and this varied by day of week from 78.0 to 83.7 percent. An average of 51.5 percent of all households contacted (57.2 percent of all eligible households, and 63.3 percent of all households mailed surveys) responded to the mail survey, with a variation from 48.5 to 55.2 percent by day of week.

The data in Tables 3-6 give the distributions of interviews by household size and vehicle availability. The zeroes in Tables 4-6 are in those cells where no mail surveys were designed to be sent out. Only 7 of the 12 cells of the matrix were designed

TABLE 2 Distribution of Telephone and Mail-Back Surveys by Day of Week Called

Day	Interviews	Eligible for Mail		Sent Out		Returned	
		No.	Percent[a]	No.	Percent[a]	No.	Percent[a]
Monday	430	398	92.6	360	83.7	229	53.3
Tuesday	467	423	90.6	380	81.4	232	49.7
Wednesday	519	453	87.3	405	78.0	256	49.3
Thursday	382	350	91.6	312	81.6	207	54.2
Friday	524	472	90.1	435	83.0	289	55.2
Saturday	561	499	88.9	457	81.5	272	48.5
Total	2,883	2,595	90.5	2,340	81.5	1,485	51.5

Note: Data are from Schimpeler-Corradino Associates.

[a]Percentages are of interviews conducted.

TABLE 3 Distribution of Telephone Interviews Conducted

Vehicles per Household	Distribution by Persons per Household: 1		2-3		4		≥5		Total	
	No.	Percent	No.	Percent	No.	Percent	No.	Percent	No.	Percent
0	65	2.25	98	3.40	14	0.49	16	0.55	193	6.69
1	188	6.52	588	20.40	164	5.69	126	4.37	1,066	36.98
≥2	24	0.83	653	22.65	462	16.02	485	16.82	1,624	56.33
Total	277	9.60	1,339	46.45	640	22.20	627	21.74	2,883	100.00

Note: Data are from Schimpeler-Corradino Associates.

TABLE 4 Distribution of Interviews Eligible for Mailing

Vehicles per Household	Distribution by Persons per Household: 1	2-3	4	≥5	Total
0	0	97	0	0	97
1	188	586	0	126	900
≥2	0	653	462	483	1,598
Total	188	1,336	462	609	2,595

Note: Data are from Schimpeler-Corradino Associates.

TABLE 5 Distribution of Interviews Mailed Out

Vehicles per Household	Distribution by Persons per Household: 1	2-3	4	≥5	Total
0	0	87	0	0	87
1	165	527	0	114	806
≥2	0	583	422	451	1,456
Total	165	1,197	422	565	2,349

Note: Data are from Schimpeler-Corradino Associates.

for mail out. From the data in Table 3 it can be seen that the omitted cells comprise 9.8 percent of the households interviewed by telephone. Primarily, the differences between Tables 4 and 5 are those households that refused to provide an address. In Table 6 the percentages of mail surveys returned in each cell are given. With the exception of the 2- and 3-person households with no vehicles, the rates are quite similar and show an even response over the matrix.

The high mail-back response to the survey is considered to have been achieved, at least in large measure, by the telephone recontact on the day before the travel-diary day for each household. In general, the reaction to recontact was positive. Many respondents indicated that they were ready to complete the forms and had no questions. An almost equal number either had not opened the package but did so under the prompting of the interviewer, or had opened it and had questions about the materials. A number of those contacted indicated initially that they did not plan to respond, but some of those appeared to be persuaded to do so by the interviewer. The remaining contacts generally indicated an assortment of problems, most of which occurred only once or twice in each evening and probably constituted not more than 1 to 2 percent of all mail outs, although a precise count was not maintained.

1. Some contacted households indicated they had not received the survey package, even though the address was verified as correct. No action was taken on those, because it was assumed that the Post Office had delayed delivery or the person contacted had overlooked the arrival of the package or was unaware of it.
2. Some contacted households indicated they had not received the survey and an error was found in the address. This error appeared to include the respondent having given an incorrect or incomplete address, the telephone interviewer making an error in transcribing the address, or a keypunch error in the address. These were corrected, and a new package was sent out.
3. In some instances the telephone number called was of someone completely different from the name and address recorded. Whenever possible, the name and address were then looked up in the telephone directory and the correct telephone number inserted. In many of these cases, however, the name and address were not listed. From a log kept that indicated the section of a page of computer-generated telephone numbers that an interviewer called each evening and from the interviewer number on the telephone-interview form, the telephone numbers called were searched. This search used a reverse directory to check each marked number for the name and address in question. Through this process, about half of these cases were recovered and correct telephone numbers appended. Some of these instances were recovered more simply, because a comparison between computer listing and original interview showed a simple keypunching error. Also, a few instances revealed a different name but the same address and subsequently were found to indicate a multifamily household. The remainder could not be traced and, for them, the telephone number on the computer record was removed.

The return profile for the mail-back survey is given in Table 7. Not unexpectedly, this profile shows that returns generally peaked two to three days after the designated diary day, suggesting that most respondents completed their travel diaries on the designated day. After the tenth day from the interview (thirteenth for Saturday, with its delayed diary days), the response declines quite rapidly, but there was a small increase around the fifteenth to sixteenth days following the postcard reminder and second diary day. There is, however, no way to

TABLE 6 Distribution of Interviews Returned

Vehicles per Household	Distribution by Persons per Household: 1		2-3		4		≥5		Total
	No.	Percent	No.	Percent	No.	Percent	No.	Percent	
0	0		41	47.1	0		0		41
1	115	69.7	340	64.5	0		65	57.0	520
≥2	0		386	66.2	266	63.0	272	60.3	924
Total	115		767		266		337		1,485

Note: Data are from Schimpeler-Corradino Associates.

TABLE 7 Return Profile for Mail-Back Surveys

Days from Interview	Return Profile (%) by Day of Week of Interview					
	Monday	Tuesday	Wednesday	Thursday	Friday	Saturday
6	0.4	0.4	0	0.5	0.3	5.1
7[a]	0.4	1.3	1.4	1.0	1.7	1.1
8	15.7	10.3	0.4	11.6	1.7	8.4
9	31.9	15.9	15.2	11.1	19.4	0.4
10	7.9	25.0	17.0	24.6	14.6	1.8[b]
11	12.7	13.4	14.4	5.8	17.7	9.9[b]
12	9.6	3.0	5.1	11.6	17.0	11.0
13	1.3	6.5	6.1	10.6	2.4	18.3
14[c]	0.4	1.3	9.0	1.9	4.2	11.7
15	3.5	7.8	2.2	4.8	4.9	3.3
16	5.7	2.6	2.9	3.9	0	2.2
17	1.7	2.6	5.8	0.5	2.8	1.5[b]
18	2.2	2.6	0.4	1.9	2.1	4.8[b]
19	1.3	0	1.4	0.5	3.1	2.2
20	0	0.9	1.1	3.4	2.1	1.5
21[d]	0.4	0.4	0.7	0.5	0.7	5.5
22	1.3	0.4	0	0.5	0	0
23	0.4	0.4	0.4	0.5	0	1.5
24	0	0.9	1.8	0	0.7	1.8[b]
25	0.9	0.4	0	1.0	0.3	0.4[b]
Other	2.2	3.9	5.1	3.9	6.3	7.7

Note: Data are from Schimpeler-Corradino Associates.

[a]Diary day.
[b]Travel-diary days for Saturday interviews.
[c]Diary day 2.
[d]Diary day 3.

define how many responses were received as a result of the reminder postcard. It appears to be in the range of 8 to 12 percent of all returns. A small additional surge occurred after the third diary day, although the total volume of this was, as expected, small. Most of the remaining responses came from a targeted remailing of survey packages that occurred about 30 to 35 days after the original interviews. The remailing was a targeted remailing sent to households in certain zip codes and categories of household size and vehicle availability that were considered to have a response rate that was significantly below the general response rate. A total of 190 such mailings were sent out, of which 27 (14.2 percent) were returned.

With respect to this targeted remailing, it is interesting to speculate that, if the original plan to send a remailing to all nonresponding households had been executed, an extrapolation of this response might indicate the size of the final response that could have been achieved. A total of 863 remailings could have been made, given the nonresponding total, and a 14 percent response from this would have added a further 121 responses that might have been obtained, leading to an increase of 5.2 percent in the response rate for households receiving mail surveys. Such a reminder process should have achieved a final response rate of 67.5 percent. It is also reasonable to suppose that the targeted households for this remailing were inclined to be more nonresponsive than the average, so that it may also be speculated that this represents the low end of the potential response achievable.

Follow-up for Missing Data

Included in all of the response figures are all packages received by mail. Of these, 24 packages proved to be outright refusals, with the forms returned blank, which reduced the response total to 1,461 and the response rate by 1.6 percent. In addition, 37 of the 2,338 packages mailed were returned by the Post Office as undeliverable and no correct address was found from reverse directories, recontact telephone calls, or all other means available. These also are considered to constitute refusals, in that probably an intentional wrong address was provided. However, these 37 were not included in any of the reported returns. The refusals that were mailed back are evenly distributed over the household types defined by the trip-production matrix.

Subsequent analysis of the remaining returns revealed various elements of missing or conflicting data. It had been decided much earlier that a return would be considered complete if it was missing not more than one-third of the travel diaries that should be returned (i.e., no travel diaries missing for households sent one or two; one missing for households sent two through five; and two missing for those sent six through nine), and that critical questions on household size, vehicle availability, and household location had been answered on the mail-back forms. In those cases where the returned survey would be described as incomplete on this basis and, in addition, when any information was missing from the household survey form or any travel diaries were blank or missing, an attempt to complete the data by telephone was undertaken. A second category of responses requiring follow-up was identified: this was when critical data provided in the telephone interview differed from the data provided in the mail-back survey. Resolution of such conflicts was considered to warrant a telephone call. In many instances the conflicts were found to have arisen because of changes in the household between the original telephone interview and the travel-diary day, or because of an error in the information given to the telephone interviewer.

This follow-up procedure was reasonably successful in completing otherwise incomplete surveys and resolving conflicts, and it was relatively inexpensive at $2.00 per household. However, 90 responses were classified as too incomplete to be usable, reducing the final usable sample to 1,370 observations. The distribution of these complete surveys by the two primary categorization variables is given in Table 8.

USEFULNESS OF RESULTS

The data produced by this survey have been used subsequently to develop new models of trip generation and modal split for long-range regional transporta-

TABLE 8 Distribution of Usable Surveys by Household Size and Vehicle Availability

Vehicles per Household	Distribution by Persons per Household				
	1	2-3	4	≥5	Total
0	5	33	0	2	40
1	116	310	6	56	488
≥2	1	356	237	249	843
Total	122	699	243	307	1,371

Note: Data are from Schimpeler-Corradino Associates.

tion planning in Oahu. The data could be used, but have not been, for recalibrating the trip-length distributions for the gravity model. As a brief summary of the results obtained from the data, it can be noted that cross-classification models of trip production were produced for six purposes, and estimates of trip rates by households were produced that compared favorably with rates from other recent studies. For example, the weighted average person trip rate for Oahu was determined to be 3.08 motorized trips per day, compared with rates of 2.80 (1980) and 2.46 (1965) in southeast Michigan, 3.00 (1977) and 1.66 (1962) in Baltimore, and 1.57 (1977) in San Juan. Earlier studies in Oahu had also indicated a tendency for households on the island to show a higher trip-making rate than households on the mainland. It is also speculated that the travel-diary approach is more successful in obtaining a reasonably complete report of trip making.

Similarly, logit models of mode choice were calibrated for four purposes--home-based work, home-based school, home-based other, and nonhome based--with calibration data sets of 458, 329, 361, and 277 for the four purposes, respectively. Satisfactory models were obtained in each case, with coefficients that were within the expected ranges, t-scores that exceeded the 99 percent significance level, and satisfactory chi-square and rho-square statistics. For the selected models, the chi-square for home-based work was 355.3, with 9 degrees of freedom (df); for home-based school it was 134.1, with 8 df; for home-based other it was 34.0, with 6 df; and for non-home-based trips the chi-square was 113.8, also with 6 df. These all indicate reasonable fits to the data, and indicate that the data collected were clearly adequate for the job.

CONCLUSIONS

The case study reported in this paper demonstrates a procedure by which an intensive survey, based on travel diaries, was administered by telephone and mail and achieved a 50 percent saving in the survey cost per completed return, compared with the use of personal interviewers. The final result of this survey was the achievement of a mail-back response of 1,370 usable household returns, which represented a 58.5 percent response rate for the mail-back portion of the survey. Because the survey described here was conducted very much as a pioneering effort, it is considered that this response rate should be able to be improved further in subsequent refinements of the procedure.

The survey used some duplicate questioning so that it is also possible to deduce the nonresponse biases of the mail-back survey. This has not been explored in this paper, but it is an important element of the validity and value of a survey of this type.

The data produced have been used subsequently to develop new models of trip generation and modal split for long-range regional transportation planning on Oahu. The data could be used, but have not been, for recalibrating the trip-length distributions for the gravity model.

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