

Design and Conduct of a Statewide Household Travel Survey in Vermont

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In their efforts to develop a statewide travel demand model, the Vermont Agency of Transportation and its consultant, Vanasse Hangen Brustlin Inc., rejected the option of using data gathered from another area because of the unique character of Vermont and the lifestyle of its residents. This choice was further supported by the need to develop regional submodels within the statewide structure. The agency decided to conduct travel surveys, one of which would include a representative sample of households in the state. A discussion is presented of the process followed in collecting the data required to develop the models. Because of the renewed interest in travel demand modeling created by the Intermodal Surface Transportation Efficiency Act of 1991 and the Clean Air Act Amendments of 1990, practitioners should find the activities and costs associated with this effort helpful in making decisions regarding household socioeconomic and travel inventories they might be planning to undertake. The paper focuses on sample selection, form design, printing, mailing, receipt, and quality control associated with the administration of the survey.

The information presented in this paper regarding techniques, results, and costs of a statewide mail-out/mail-back household travel survey conducted in 1994 should be beneficial to practitioners considering, or about to undertake, some form of household-level travel data collection effort. This paper presents a discussion of the process followed in collecting data required to develop a statewide travel demand model in Vermont and the cost of the activities, which include sample selection, form design, printing, mailing, receipt, and quality control associated with the administration of the surveys.

HISTORY

Since the early days of travel demand model development, household surveys have been the major source of socioeconomic and travel-related data. The information gathered through inventories of household and trip-making characteristics has been used to establish three basic interrelationships of the traditional four-step modeling process, namely, trip generation and distribution and mode share.

In the early 1960s, large-scale surveys were conducted to gather the information needed to develop travel demand models. Initial data collection efforts used the personal home interview technique, and the surveys were conducted in a door-to-door campaign, a method that was time consuming and costly. In the late 1960s and early 1970s, other techniques were applied to reduce the costs associated with these data compilation efforts. Popular alternative

approaches to obtaining household characteristics and travel data were telephone and mail surveys. Each had advantages and disadvantages, although the deciding factor was usually a combination of data reliability and cost.

In 1991 the passage of the landmark Intermodal Surface Transportation Efficiency Act stimulated a renewed interest in travel demand modeling and in obtaining current socioeconomic and trip-making relationships, particularly with regard to time-of-day travel and information required to develop disaggregate models and other innovative applications. Peak-hour estimating capabilities are particularly important to satisfy some of the requirements of another significant piece of legislation, the Clean Air Act Amendments of 1990.

BACKGROUND

In their efforts to develop a statewide travel demand model, the Vermont Agency of Transportation (VAOT) and its consultant, Vanasse Hangen Brustlin Inc., (VHB), decided that it would be necessary to conduct travel surveys, one of which would include a representative sample of households in the state. The VAOT chose not to use data from other studies because of the statewide-regional nature of the model structure and because of the unique character of Vermont and the lifestyle of its residents. The Nationwide Personal Transportation Survey was also considered, but the small sample size in Vermont would require use of regional data, which include information from highly urbanized areas in New England.

In recent years, a number of data collection techniques have been developed and tested. Some of the more advanced are diary surveys and panel surveys. These data collection efforts can be for a point in time or an extended period. Methods to gather the information rely on personal, mail, or telephone contact with various follow-up techniques to enhance return rates. A number of documents and publications were reviewed, and various techniques for conducting household surveys were evaluated. The mail-out/mail-back method was selected for the following reasons:

- Personal interviews are time consuming and costly.
- Telephone interviews, although efficient and requiring fewer household contacts to obtain the required sample, generally use a random dialing technique, which does not guarantee a geographically representative sample. Also, competition by myriad tele-marketing efforts of commercial enterprises could discourage participation by some households.
- The mail technique, although requiring a mailing to a greater number of households to obtain the necessary sample size, would ensure the representative samples needed for model development. However, one drawback of the mail-out/mail-back survey tech-

nique is that nonresponse bias cannot be evaluated because what is missing is unknown.

SAMPLE SELECTION

One of the objectives of the sample selection was to obtain a geographical representation. A target of 1 percent of the dwellings was established to provide sufficient data to develop a cross-classification approach to trip generation, trip length characteristics for trip distribution model parameters, and mode share characteristics. According to the 1990 Census Transportation Planning Package, there are approximately 218,900 dwellings in Vermont. Assuming a 10 to 15 percent response rate, approximately 28,200, or 13 percent, were selected to receive questionnaires.

The next task was to locate a list of mailing addresses from which a sample could be selected. Candidate sources were telephone directories, tax assessor maps, and commercial mail houses that specialize in such lists. The last proved to be the best choice because this service included generation of mailing labels and a control list. The company selected for this task also printed the survey questionnaire, inserted serial numbers on the mailing labels, and assumed responsibility for mailing the forms. The printer was provided a list of towns in Vermont with the number of deliverable addresses required in each.

FORM DESIGN

Two basic types of household information are necessary for model development: demographic characteristics of members of the specified households and trip-making characteristics of household members. The first includes information on age, sex, employment status, number of automobiles available, and income level. These data are required to establish trip rates for various socioeconomic parameters. Such rates can then be used by the state and regions to forecast travel demands for specific geographic areas. Required trip information includes origin and destination data by time and place, travel mode, vehicle occupancy, and trip purpose. Design of the survey form would have to incorporate each of these needs.

A preliminary survey package was developed that consisted of the following components:

- A letter from the Governor of Vermont soliciting cooperation and explaining the purpose of and need for the survey,
- A set of instructions on how to complete the survey package,
- A form soliciting demographic information about the household and its members,
- A form with questions on transportation prepared by the VAOT plus space for the respondent to express an opinion on anything related to transportation,
- A series of forms asking for information on trips made by household members on one particular survey day, and
- Maps to be developed for use by the respondent to identify trip origins and destinations by traffic analysis zone.

The initial concept was to develop the survey package as an unbound series of individual sheets that would be used to solicit trip information from household members aged 5 or more, to ask for such information for the day before receipt of the survey package in the mail, and to use the map technique to minimize subsequent

effort required to translate address or place-name information into the traffic analysis zone format required by the model. Other aspects of the survey identified during this early phase included

- Exploration of the possibility and desirability of an incentive (monetary prize or premium) to help increase the survey response rate;
- Provision of a toll-free telephone number so that potential respondents could contact the survey team for assistance, additional forms, or other reasons;
- Use of a separate diary form for each household member;
- Use of informal language rather than the more formal and technical verbiage; and
- Use of a question-and-answer format for conveying the required instructions.

Several meetings were held to solicit comments on early design efforts and refine the survey procedures. This process resulted in the following decisions:

- To use a booklet-type format that could be mailed directly, eliminating the need for separate envelopes. This approach reduced the survey's complexity and cost, as well as the probability that individual sheets would be lost or damaged by respondents.
- To use an 8½-in. by 11-in. format for readability and to reduce the mailed booklet's size by folding it to 8½ in. by 5½ in. to reduce postage costs. Reversing the fold and resealing by the respondent after completion of the survey resulted in a returnable package.
- To limit the booklet's composition to four 11-in. by 17-in. sheets (16 printed pages of 8½ in. by 11 in.) to minimize weight and reduce postage costs.
- To avoid mention of VHB in the survey package to emphasize that this was a VAOT survey. It was decided that a better response would be achieved with a return address to VAOT in Montpelier rather than to VHB in Massachusetts. VAOT forwarded all returns to VHB for processing.
- To minimize printing costs by using only one color and one paper weight for all pages of the survey package so that only one press run would be required.
- To abandon the concept of the traffic zone map because of time constraints and to keep things as simple as possible for the respondent. Because of the statewide nature of the survey, only partial map coverage was practical, necessitating a combined zone/address technique that could have caused confusion. Also, map reading and interpretation could have been a problem for some respondents.
- To abandon the incentive approach because cost considerations of a large mailout (more than 28,000 surveys) precluded giving everyone a premium and because the likely benefit derived from distributing a few small prizes was thought to be limited.
- To provide a toll-free telephone number with instructions to call during normal business hours. An answering machine was activated after working hours to provide continuous access.
- To use informal language and a question-and-answer format.
- To retain the separate trip diary form technique and provide extra forms for large households or for household members making many trips.
- To designate a nonspecific survey day rather than a predetermined day for each household because of the relative unpredictability of the delivery schedule of third-class mail, which, according to the post office, is typically 1 to 2 weeks.

- To designate the survey day for each household as the day immediately after receipt of the survey rather than before. This reduced recall problems associated with recording trips made the previous day.

- To solicit only weekday information because the model would have to replicate typical daily travel, which in most cases and geographic areas includes weekday commuter travel.

- To stagger mailings to obtain trip information for a sampling of weekdays rather than for one particular day.

- To solicit information only for "reportable trips," which are important to the development of the vehicular and transit trip models. Incidental trips, duplicate trips, and trips typically included only for the sake of comprehensiveness were eliminated to the extent possible to reduce the amount of information the respondent had to record.

- To eliminate mention of an age cutoff for trip making. All trips by members of a household were considered important regardless of the person's age.

- To provide a sample form to demonstrate how to complete the trip diary.

- To exclude college students from the survey. This decision was based on considerations of time (most college students would be either finished with school or focused on final examinations by the time of the survey), effort (they would require special technical and administrative procedures to handle), and size of group (they made up only a very small part of the total statewide universe).

SURVEY METHOD

VHB decided that a staggered mail-out system was desirable to produce trip information on each weekday. The mail-out schedule established with the vendor was to deliver survey booklets to the post office over several days. Because Wednesday, May 11, was the first possible day for mailing, Friday, May 13, was specified as the last mail-out day. This schedule allowed sufficient time between receipt of the survey and the Memorial Day weekend, because the post office was estimating a 1-week to 10-day delivery time frame rather than up to 2 weeks, as mentioned earlier. Although it was not possible to control the delivery schedule, VHB estimated there would be a sufficient natural stagger across the state to allow for survey responses representative of each weekday. This mail-out schedule was accomplished by the selected print/mail house as planned. Approximately 4,700 survey forms were sent out on Wednesday, May 11; 12,500 on Thursday, May 12; and 11,000 on Friday, May 13. Distribution by town and region followed the calculated sample-size targets as closely as possible, although some modification was necessary because of recent ZIP code reassignments made by Vermont postal authorities.

On Monday, May 16, VHB began to receive telephone calls on the toll-free number established for the survey. Additional calls came in over the next week or so, indicating that most people received the forms within a few days of mail-out rather than the 2-week worst-case time frame initially estimated by the post office.

By June 1, 46 calls had been received. The nature of the calls was mixed. Many were to request clarification about the definition of a trip, to say they made few trips or none on the survey day, or to ask what to do if they missed the survey day. Some requested guidance because the form was sent to a deceased, ill, or elderly relative. Several had concerns about privacy and said they would not fill out the form or would remove the label before sending it in. A few had

questions or comments about a gasoline tax question. A small number said they had received more than one form or received the form at their place of business. Two thought the survey was a waste of time and money and refused to complete the forms.

As surveys arrived at VAOT, they were packaged and sent to VHB in batches, where every returned survey form was logged by staff members who recorded the serial number, town name, and ZIP code from the form's mailing label. A custom computer spreadsheet was developed for this purpose, which facilitated sorting the form's contents; the spreadsheet also automatically kept a running count of the number of entries. In the event that the label was removed by a respondent for privacy reasons, the inside of the form was inspected for town and ZIP code information and, if available, recorded. In this case a notation was made in the spreadsheet indicating that usable information was available despite the lack of a mailing label. It is ironic that most respondents who removed the mailing label, presumably for privacy reasons, did not hesitate to provide their telephone number, which was requested to allow a follow-up call if necessary. If the respondent provided no information for whatever reason, the form was logged as a return but recorded as having no usable information. To prevent double counting, each form was marked to indicate that it had been processed. The rate of return of survey booklets by time after mailing is shown in Figure 1.

A small percentage of forms were still being received more than a month after they were mailed. On these late returns, some respondents apparently attempted to provide trip information for the day after they received the survey, as requested. Others ignored that instruction and completed the form for a more recent day, presumably because it was easier to remember. Some respondents filled in only household-related information, perhaps thinking that too much time had passed since they received the booklet to remember past trips but not wanting to ignore the timing instruction.

RESULTS

ZIP codes from the above-mentioned tabulation were copied to another spreadsheet, which was developed to summarize return statistics by individual towns within each Regional Planning Commission (RPC) area, as well as for the entire state. The table included, for each town/ZIP code, the original target sample desired, the actual number of survey forms mailed and returned, and the percent returned. In some cases towns were combined with others when the local ZIP code system dictated such an arrangement.

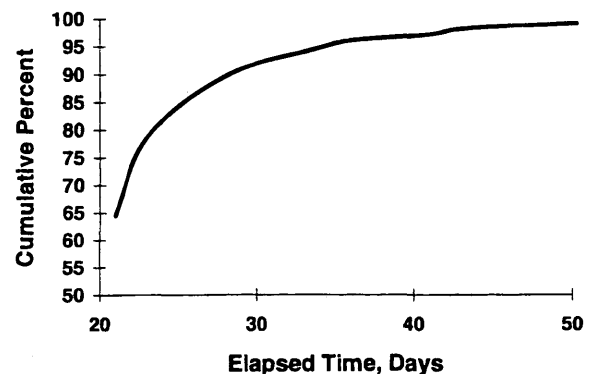


FIGURE 1 Survey returns by time.

The spreadsheet was set up to automatically update each new batch of ZIP codes and modify the return statistics by location. Table 1 summarizes the key information by RPC.

The 2,447 returned survey forms represent 1.1 percent of the total number of households in Vermont. On a regional basis, the Addison RPC had a return rate of 13.7 percent, whereas response rates for the other RPCs were generally in the 7 to 9 percent range.

The only presurvey activity was a news release by the VAOT public relations unit to announce the survey. Given the complexity of the information requested and the lack of an initial contact phase to identify likely respondents or solicit cooperation, the returns were sufficient for the purposes of this project. No follow-up telephone calls or supplementary mailings were made to increase the response rate. A meaningful increase in returns would be forthcoming only through significant additional expense.

The cost to design and conduct the household survey was approximately \$17.50 per returned survey. The cost breakdown is shown below. The first two components are best estimates, and the last two represent actual costs.

Item	Cost(\$)
Planning and design of survey form and presurvey arrangements	10.70
Production (develop mailing list, print, bind, etc.)	3.90
Third-class outgoing postage	2.30
First-class return postage	0.60
Total	17.50

Of the forms returned, approximately 79 percent were fully usable and an additional 17 percent were made usable through an editing process. The remaining 4 percent were unusable.

CONCLUSIONS

The results of the Vermont statewide household survey indicate that the mail-out/mail-back technique for obtaining information on household demographic and travel characteristics without advance

contact with potential respondents represents a viable and cost-effective approach. It is a relatively simple procedure to organize and administer, and it results in data with an acceptable level of reliability. However, given the lack of advance contact and the complexity associated with this type of survey, the practitioner can expect a return rate of 8 to 10 percent compared with the typical 15 to 25 percent associated with less complex mail-type surveys. VHB was prepared for a lower-than-average return because of some small-scale advance testing. Advance contact by mail or telephone could have improved the return rate, although at a higher cost. Also, an incentive program of some sort could be beneficial in cases for which the survey area is of reasonable size. This household survey involved the entire state of Vermont, and the cost to implement a meaningful incentive program was prohibitive. Follow-up contact by mail or telephone could also improve the return rate, again at a higher cost. The survey practitioner must evaluate project needs and determine whether achieving a higher response rate is worth the additional cost.

For the Vermont survey, the selected format worked well. Everything required was contained in one package, precluding the need for separate mailing envelopes and upfront handling. The 8½-in. by 11-in. size was large enough for readability without sacrificing the postage benefits of a low-weight piece. The booklets held up well for the most part and, except where purposely detached by some respondents for privacy reasons, had no missing pages on return. Based on a preliminary review of the returns, fewer household member trip diary pages would have been sufficient than the eight provided.

Caution is advised in the development of a mailing list. The selected method of using a printing vendor to provide an address list resulted in inconsistencies. For example, the address list was approximately one-half the total number of households in the state. The list was supposed to be a "clean" one, having only "deliverable" addresses. If this approach is used, one should be certain that the smaller list has a geographic distribution similar to the region to be surveyed thereby avoiding a potential geographic bias, which was the purpose of this project. A second condition required the shifting of addresses among towns because of the lack of sufficient

TABLE 1 Survey Return Statistics

Regional Planning Commission	Households	Mailings	Percent	Returns ¹	Percent
Addison	13,606	1,714	12.60	234	13.7
Bennington	16,461	2,095	12.73	173	8.3
Central Vermont	27,264	4,248	15.58	330	7.8
Franklin - Grand Isle	21,385	2,555	11.95	179	7.0
Lamoille	9,872	1,441	14.60	108	7.5
Northeastern Vermont	30,849	3,593	11.65	332	9.2
Rutland	30,646	3,833	12.51	306	8.0
Southern Windsor	13,675	1,988	14.54	175	8.8
Two Rivers - Upper Valley	26,923	3,144	11.68	285	9.1
Windham	28,312	3,584	12.66	303	8.5
TOTALS	218,993	28,195	12.87	2,425	8.6

1. Unknown zip codes account for an additional 22 returns not assignable to an RPC

addresses in certain communities to meet the desired sample size. This was acceptable for the Vermont survey because it was more important to achieve a representative sample at the regional level than by individual town. A third inconsistency was that peculiarities in the state's postal system necessitated combining some ZIP codes. In one case, substitute forms had to be sent to one town that had been divided into five ZIP codes. Finally, some forms were returned with notes indicating that the addressee had been deceased for some time, raising a question regarding the age of the list. The advantage of using a vendor to provide an address list is that they

typically rent the list for one-time use from a commercial provider and are responsible for dealing with such anomalies. However, if the vendor is less reliable or conscientious than the one selected by VHB, one might never learn about these issues. A thorough check of vendor credentials, along with a detailed investigation of its mailing list, particularly with regard to the issues identified above, is essential at the selection stage.

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