

Current Issues in Travel and Activity Surveys

Resource Paper on Travel Behaviour Measurement

For the 8th Meeting of the IATBR, Austin, Texas, September 21-25, 1997

Prof. Tony Richardson

Director, Transport Research Centre

RMIT University, Melbourne, Australia (at time of conference)

Director, The Urban Transport Institute

Melbourne, Australia (at time of publication)

Introduction

The field of travel behavior measurement has been active in one form or another for about 50 years. However, it has only been in the last 20 years that it has been taken seriously as an area of professional activity. In that time, and parallel to the series of conferences held under the IATBR banner, a number of international conferences have been held which have attempted to raise the quality of surveys of travel and activity behavior. These conferences started in Germany in 1979, and continued in Australia in 1983, in Washington D.C. in 1990, in the United Kingdom on 1996, and most recently returning to Germany in 1997 where a major international conference on quality in travel surveys was held in Grainau in May 1997.

As a reflection of current interests in travel survey methodology, the Grainau Conference was structured around twelve workshop themes, complemented by a range of plenary sessions on issues of broader interest. The workshop themes were:

1. Multi-instrument and multi-method surveys
2. Respondent sampling, weighting and non-response
3. Item non-response
4. Quality indicators
5. Multiday and multiperiod data
6. Respondent burden
7. Hypothetical situations
8. Practitioners' future needs
9. Modellers' needs
10. Qualitative survey methods
11. Data presentation
12. Questionnaire design

As a means of focussing attention on some of the key current issues in travel behavior measurement, this paper summarizes the major issues arising out of the Grainau Conference. While the Grainau Conference was structured around twelve distinct workshop themes, the following discussion will be structured around the twelve components of the survey process, as identified by Richardson, Ampt and Meyburg (1995) and as shown in Figure 1.

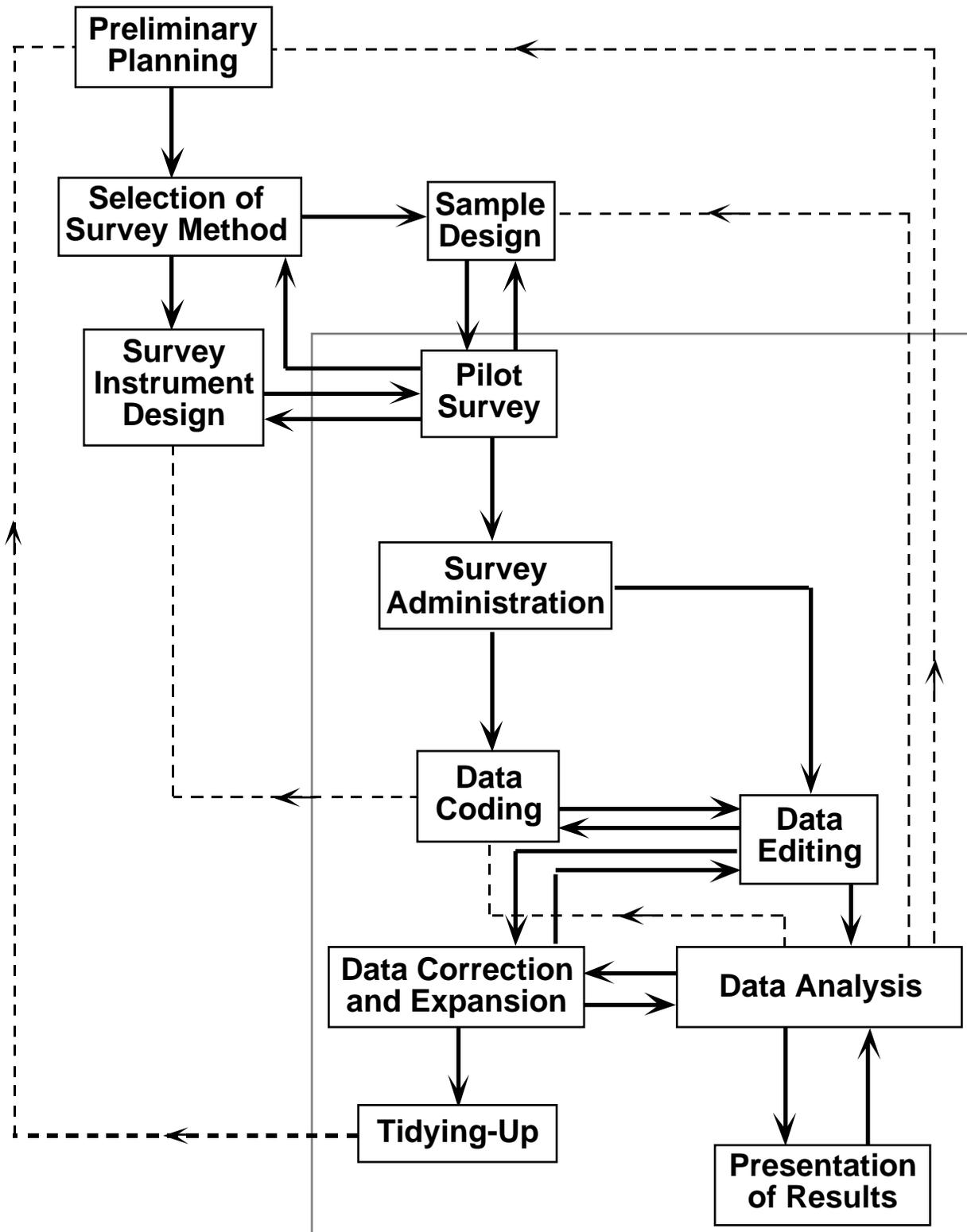


Figure 1 The Travel Survey Process

Preliminary Planning

The idea behind the preliminary planning stage of the survey process is to determine whether a survey needs to be performed and, if so, what are the overall guidelines for the survey design. An objective of the Grainau Conference was to develop a set of “industry guidelines” on the state of practice in travel survey methodology to assist those starting out on the task of designing a travel survey. These “guidelines” would serve three major roles:

- to document minimum standards that are considered necessary in any travel survey
- to inform clients of what should be expected from “quality” surveys
- to provide advice to survey designers on various technical aspects of survey design

There was seen to be a major need for “educating” clients as to what should be expected from travel surveys. Too often, clients try to cut corners in an attempt to minimize the short-run costs of the survey. However, this often leads to higher long-run costs and, in many cases, unusable data. By having an industry-approved set of guidelines that would serve as a benchmark against which survey proposals could be judged, it was felt that the interests of clients and survey designers could be best protected.

In order to have the guidelines accepted as widely as possible on an international scale, it was felt desirable to have the backing of a reputable “cognizant agency” who would be responsible for the production and distribution of the guidelines. Such an agency could be an organization of the standing of the OECD, or similar body.

While the development of these Guidelines was ultimately unsuccessful, one of the specific issues that emerged in Grainau that needed immediate attention was the issue of definitional consistency. Because travel and activity surveys are being conducted globally, it is necessary to ensure that similar definitions are being used to enable comparison of results. Benchmarking is becoming an increasingly popular practice, but this is of little use if different definitions are being used for key terms in data collection programs. The classic definitional problem revolves around the definition of a “trip”. Survey designers employ different definitions of a “trip”, compared to other units of travel such as “trip stages”, “trip legs”, “stops”, “journeys”, “chains”, and “sojourns” (to name just a few of the more commonly used terms). Despite this identified need, confusion still exists in the terminology applied to travel. For example, in the MEST project of long-distance travel currently being conducted in Europe (Axhausen ref, 199?), half the participating countries are assuming that a “journey” is part of a “trip” (in line with tourism survey practice), while the remainder are assuming that a “trip” is part of a “journey” (in line with urban travel survey practice). While each country may know what they mean by their own terminology, outside readers of the documents are completely confused by the inconsistent terminology used within the one project. This problem of consistent definitions applies to many other areas as well, and was seen to be one of the immediate issues to be covered by any set of “guidelines”.

Selection of Survey Method

In selecting the type of survey method to be used in any particular instance, four specific issues were highlighted in Grainau:

- the use of multiple survey methods
- the timing and duration of surveys
- the role of qualitative surveys
- activity-based or trip-based recording

The use of multiple survey methods, sometimes called the Total Design approach (Dillman, 1978), was seen to be a useful method of combining the best features of various designs for a specific

situation (Goulias, 1997; Freeth, 1997). For example, respondents with low literacy levels (van der Reis, 1997) in a self-completion survey may be offered the chance to complete the survey in a face-to-face interview situation. Alternatively, telephone interviews may be used as a quality control procedure as a follow-up to a self-completion questionnaire to clarify doubtful information or to supply missing information.

The timing and duration of surveys considered a number of related issues; how frequently should surveys be performed, should surveys be continuous, how many days should be covered by each respondent, should surveys be panel or repeated cross-sections, what is the role for before-and-after surveys (Pendyala and Pas, 1997)? In addition, a plenary session paper described the benefits of continuous travel surveys and showed how continuous travel surveys have been successfully implemented in Australia (Richardson and Battellino, 1997).

The complementary roles played by quantitative and qualitative surveys were highlighted in the workshop on qualitative surveys (Grosvenor, 1997). It was shown that qualitative surveys are particularly useful in the early stages of a project when ideas are still being formulated, or when in-depth exploration of policy issues was required. In addition, qualitative questions could be used within otherwise quantitative surveys as a means of exploring topics in more depth, or just as a way of allowing respondents to have their own say in their own words.

Continuing discussion occurred on the relative merits of using activity-based or trip-based recording in travel surveys (Arentze et al., 1997). Three major options were identified; trip-based recording of travel, activity-based recording of travel (i.e. the focus is still on recording travel, but an activity framework is used to assist respondents in recording the travel), and a full activity recording framework (including in-home and in-building activities). The general consensus appeared to be that trip-based recording was far less useful and efficient. However, the choice between the latter two methods depends on the intended use of the data. Full activity diary recording is more onerous for the respondent and more demanding of analytical skills; on the other hand, activity-based trip recording gives better estimates of travel behavior in a more natural format for the respondent.

For most travel behavior studies, activity-based travel surveys should suffice, providing they can account for two specific types of “in-house” activities; “at-home” activities, such as working at home, which are a clear substitute for corresponding out-of-home activities, and “in-building” activities, such as visiting many shops within a covered regional shopping center, which would be recorded as separate activities if they occurred in an outdoor setting. However, the continuing trend towards activity-modeling may move the balance between activity surveys and travel surveys.

Sample Design

The Grainau Conference did not concentrate specifically on sample design as a workshop theme. Rather, issues of sample design entered into each of the workshops as and when required. The important issue to emerge from this was that, when sample design was mentioned, most of the attention focussed on issues of minimizing sampling bias rather than on reducing sampling error. That is, more attention was focussed on getting the correct sample rather than on getting a sample of the “correct” size. Specific issues that arose with respect to sample design included:

- the need to adopt a random sampling process, and to stick with it
- the desirability of stratifying the population, where possible, in order to obtain a more representative sample
- the sampling requirements when the data is going to be used for the development of specific types of models
- the use of replication techniques for the estimation of sample variance
- the issues involved in selection of a sampling frame, and the need to document the quality of the adopted sampling frame.

Survey Instrument Design

The issues involved in the design of survey instruments received considerable attention in several of the workshops, perhaps because of the unofficial motto of the conference: “Respondents are Customers”. Issues of respondent burden were covered extensively in the workshop on Respondent Burden (Ampt, 1997). In many cases, it was felt that introspection could provide a useful check on the burden being placed on respondents (i.e. “do unto others as you would have them do unto you”). However, survey designers also need to realize that respondents do not always have the same levels of literacy, or interest in the surveys, as the survey designer, and should design and test their surveys accordingly. The length of surveys was considered in terms of its effect on respondent burden, and hence the effects of unit non-response and item non-response. Although obvious in hindsight, the conclusion was that survey designers should remove all unnecessary questions from the survey. This sounds so simple as to not be worth saying, but sometimes it is not easy to do when clients want information collected on a wide range of issues. In this content, the “guidelines” were seen to be especially useful in educating clients about the interactions between respondent burden and quality of data obtained.

With respect to the design of Stated Preference survey instruments, it was recommended that greater emphasis be given to the needs of the respondent in the design process (Lee-Gosselin, 1997). This means tailoring the instrument to be as realistic as possible from the respondent’s point of view, and perhaps restricting the extent of the survey design such that it concentrates on obtaining information on the “main effects” in the choice process.

Pilot Surveys

The main issue with respect to pilot surveys was simply the need to do them. Almost always, failing to do pilot surveys because of time and money constraints turns out to be a false economy. Once again, the “guidelines” may be particularly useful in convincing clients of the need for performing full pilot surveys.

Survey Administration

With respect to the administration of surveys of all types, one of the main issues concerned the definition, calculation and use of response rates. In the definition of response rates, it is important to ensure that response rates are defined in a consistent fashion for different types of survey methods. This enables comparisons of response rates between survey methods. In making these comparisons, Figures 2, 3 and 4 (Richardson, Ampt and Meyburg, 1996) provide useful insights into the variety of response (and non-response) mechanisms that apply to different types of survey. Figure 2 shows the response mechanism for a mailout/mailback self-completion survey, which involves the use of reminders to non-respondents.

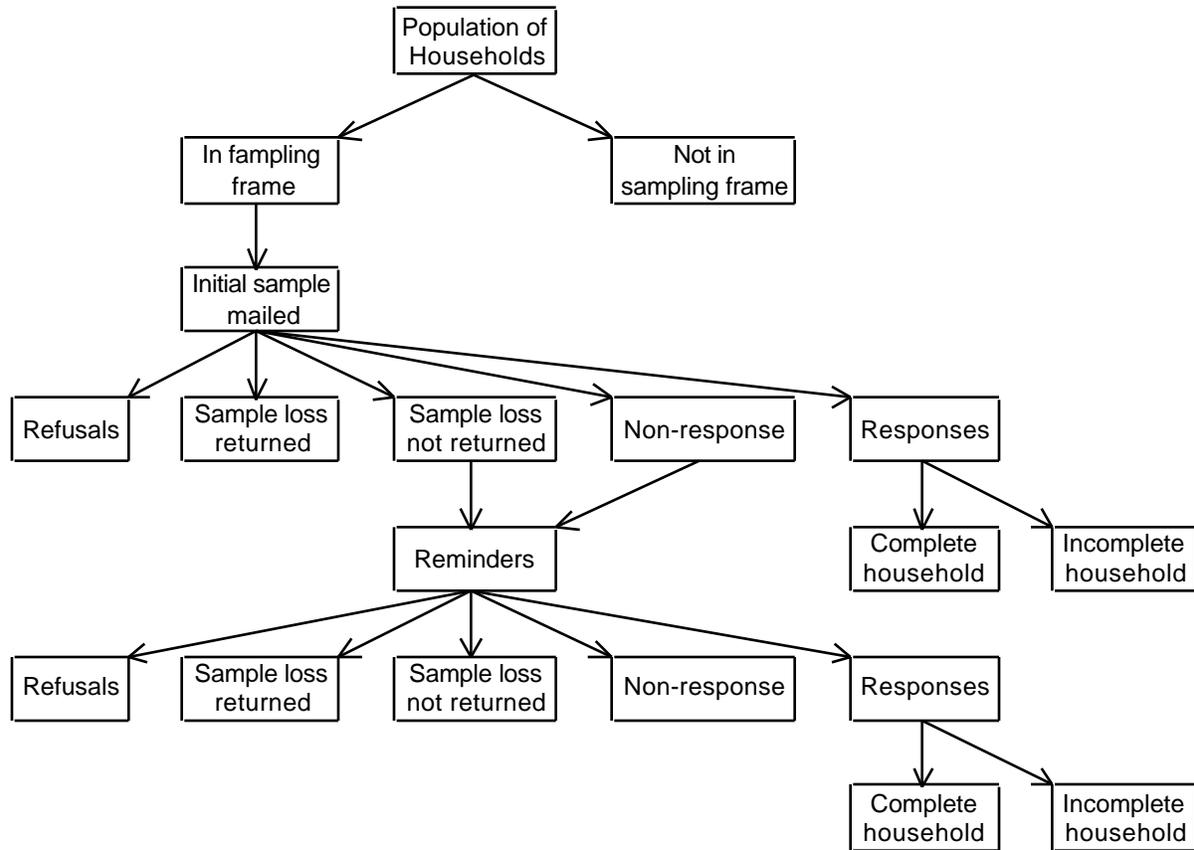


Figure 2 The Response Process for a Mailout/Mailback Questionnaire Survey

Figure 3 shows the response process for a personal interview survey, with cluster sampling and a blocklisted sampling frame, and the use of callback procedures for households which are not contacted immediately. It can be seen that the process is very different to that of Figure 2. However, in both cases the response rate would be calculated as the fraction of the original population of households that give complete household responses.

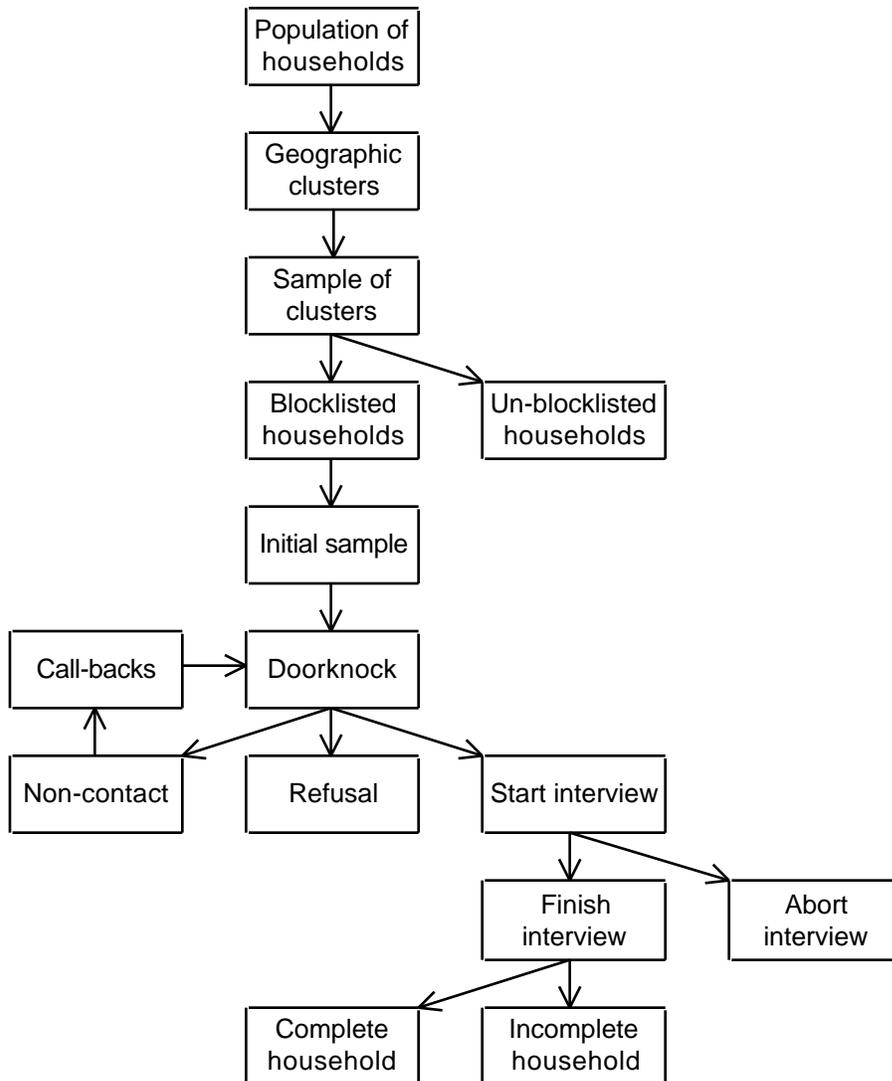


Figure 3 The Response Process for a Personal Interview Survey

The response process for a telephone survey of household travel patterns is shown in Figure 4. This survey uses listed telephone numbers for a population of households (using reverse listing to obtain the numbers), a system of call-backs for non-contacted households, the sending of travel diaries to those households which agree to participate in the survey, and the retrieval of information from the households over the phone. To be consistent with the response processes shown in Figure 2 and 3, the response rate for a telephone survey should be based on the number of households from which all diary information was retrieved as a fraction of the total number of households in the original population.

However, one will often find response rates for telephone surveys quoted as the fraction of people (not complete households) from whom diary information is retrieved as a fraction of the number of people who agreed to participate in the survey by accepting a diary. Clearly such a definition is inconsistent with the previous definitions, and biased towards the phone survey.

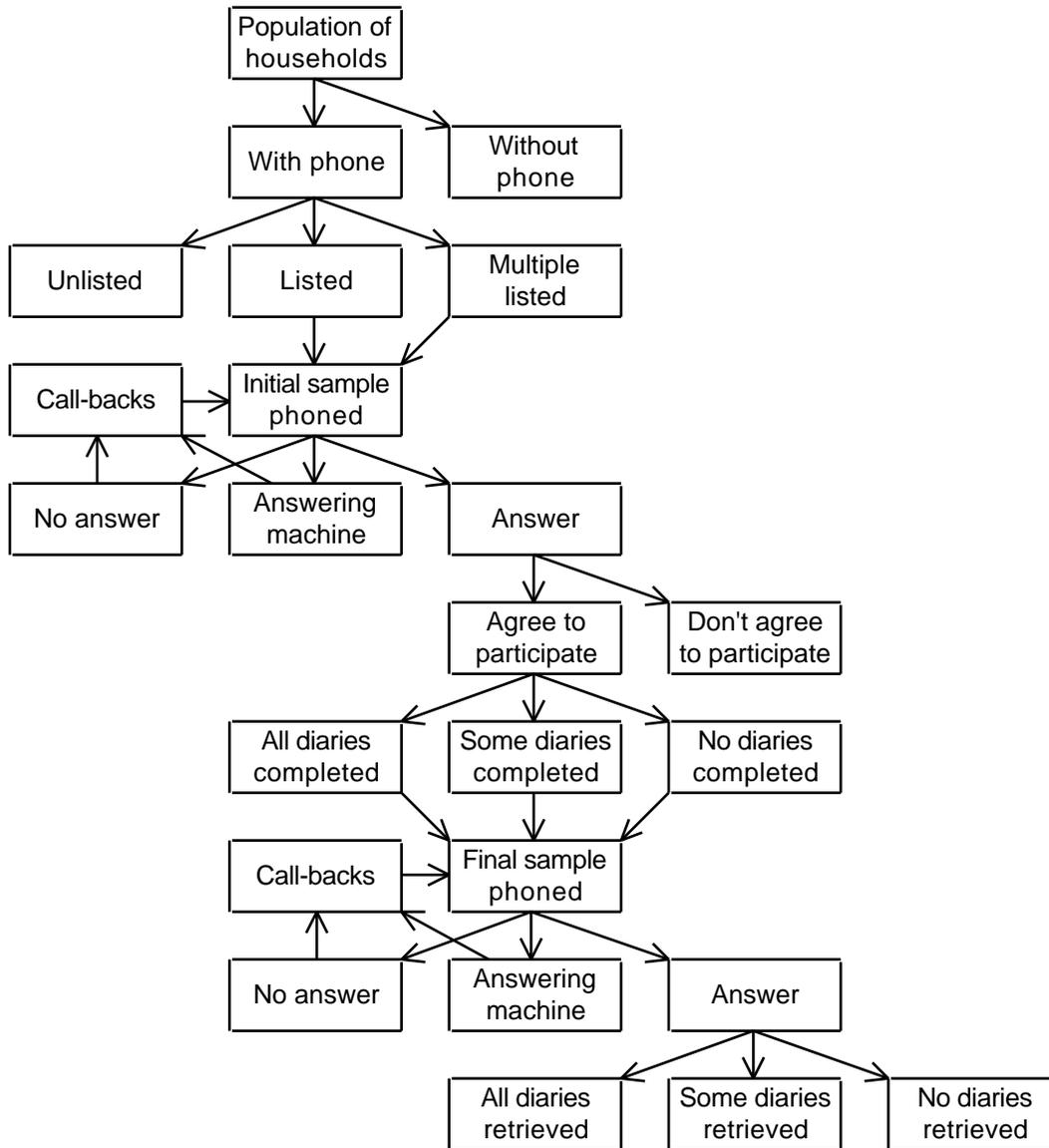


Figure 4 The Response Process for a Telephone Interview Survey

No matter which way response rates are calculated, significant debate occurred at Grainau about the use of response rates as a measure of the quality of a survey. One argument was that high response rates indicate that significant effort has gone into the design of the survey to minimize non-response, and that a high response rate offers less opportunity for non-respondent bias. The other argument was that the nature of the non-respondents is more important than the number of non-respondents. Clearly, if the non-respondents have the same demographic and travel characteristics as the respondents, then there is no need for concern about the number of non-respondents. However the problem usually is that we do not have enough information about the non-respondents to draw such a conclusion. Granted, many surveys implicitly make the assumption that non-respondents are the same as respondents by not getting any information about non-respondents and simply ignoring them. However, a much better approach is to get information about the non-respondents and then explicitly decide whether the non-respondents really are the same as the respondents.

While the need to collect information about non-respondents was the major feature of survey administration discussed at Grainau, a number of other topics were raised. The perennial question of the use of incentives as part of the survey process, as a means of increasing response rates, was discussed with the usual lack of agreement on the merits and demerits of the process. While incentives can raise response rates, this was reported not to be always the case. Examples were given of surveys in which the use of incentives appeared to reduce response rates. More importantly, in light of the above discussion about response rates, serious concerns were raised about the nature of biases introduced by the use of incentives. While incentives might increase response rates, the question was raised as to what type of respondent was attracted, and how this varied with the type of incentive offered. For example, offering free transit tickets as an incentive would most likely attract existing transit riders, offering cash might attract lower income people and so on. While these two examples of bias are obvious, the use of other types of incentive carry more subtle biases and need to be thoroughly investigated. One school of thought is that incentives of this type should be avoided altogether, and that greater emphasis should be placed on good survey design to make completion of the survey as simple as possible, thereby providing a different type of incentive to participate.

Data Coding

One of the main issues discussed under the topic of Data Coding was the increasing use of geocoding as a means of defining the spatial location of various entities in the travel survey. In this context, geocoding means more than the allocation of locations to geographic zones. Rather, it entails the description of every location in the travel survey (e.g. respondents' households and all destinations visited on the travel day) by means of latitudes and longitudes (or other x-y coordinate systems). The use of geocoding has been greatly facilitated by the increased use of Geographic Information Systems in transport planning activities. The use of geocoding allows a far higher degree of spatial checking of the data to be undertaken, and allows calculation of trip distances from a knowledge of the start and end coordinates of the trip. This is particularly enhanced if the GIS package contains a description of the road and public transport networks, allowing "on-road" or "on-board" measurements of distance to be calculated.

One issue arising from the use of geocoded locations concerns the ethical question of what level of geographical data should be released to clients. It was recommended that the x-y coordinates of all locations should remain in the database except for those belonging to the respondent's home, which should be aggregated to the finest level of zoning available in the study. In this way, the confidentiality of the respondent is upheld, while the detail in the trip chains is preserved.

Data Editing

A considerable amount of time was spent at the Grainau conference on the topic of data editing, especially in dealing with missing data. Missing data was defined as including situations in which an answer was not provided to a specific question (such as the income question) and where a respondent had failed to tell us about entire trips (i.e. non-reported trips). Several reasons were suggested for missing data (Zmud and Arce, 1997), including:

- lack of knowledge and recall problems
- comprehension of questions
- perceived or real respondent burden
- desire for privacy
- concerns about personal information
- deliberate mis-reporting

Two major means of dealing with missing data were discussed: reweighting of the data and imputation of missing data (Armoogum and Madre, 1997). Reweighting of the data involves the

calculation of specific expansion weights for each analysis to be performed to take account of the particular combinations of missing data present in each sub-set of the data. This process, however, becomes extremely tedious given the multitude of different analyses that are typically performed on a data set.

Imputation of missing data involves the estimation of values for the missing data based on some other source of information. This information may come from other respondents in the survey or from other surveys. A wide range of different imputation techniques may be used, including:

- deductive imputation
- overall mean imputation
- class mean imputation
- hot-deck imputation
- cold-deck imputation
- regression imputation
- multiple imputation
- stochastic imputation

The general conclusion from Grainau was that imputation was better than reweighting, and that imputation methods that preserve the variance in the data set (such as stochastic imputation) were better than methods which substitute a limited range of imputed values (such as class mean imputation). There was also discussion on the order in which imputation was performed for a range of variables, and the effect of using imputed variables in later model-building exercises.

Two other major issues concerning data editing were also discussed at Grainau; the use of validation models, and the cross-validation of survey data with external data sources. The use of validation models was seen to be extremely useful in detecting outliers in the data. For example, if a model is constructed in which speed of travel is calculated for different length trips by each mode of travel, then this enables the detection of possible errors in each of these variables. For example, having established the likely values of speed for each distance, a very high speed for a bicycle trip (say 70 kph) could occur because of an error in geocoding (giving rise to a shorter than expected trip), an error in recording of trip start or end times (giving rise to a quicker than expected trip) or an error in recording of mode (perhaps it was really a car-driver trip). It should be realised, however, that outliers are not necessarily wrong; there always have to be outliers on continuous distributions. The above method therefore should only be used to detect outliers, and not to automatically “correct” them.

The second issue concerned the cross-validation of survey results with external data sources, such as traffic counts and public transport patronage counts. This should occur as a matter of course to ensure that the survey results are at least in the right ballpark. However, great care needs to be taken to ensure that such comparisons are reasonably valid. For example, the two data sets should be recorded for similar time periods, for similar geographic regions and populations, and they should use similar definitions of major terms. For example, public transport agencies in different cities may have different definitions of “trips” in their counting systems to those used in a household-based travel survey. It is important to realize that, in almost all cases, both the household-based survey and the external data source are based on sample surveys, and therefore neither is necessarily better than the other.

Correction and Expansion

Given the earlier discussion of the calculation of response rates and on their use as indicators of survey quality, it was not surprising that the issue of correcting for non-response was keenly discussed at Grainau. Importantly, however, it was felt that more was needed to be known about the actual characteristics of non-respondents before corrections could be made to the data provided by

respondents. In addition, it was felt that there were considerable interactions between non-response and the non-reporting of trips. In particular, the previously-held assumption that non-respondents were more like late respondents in a mailback survey with reminders was called into serious question. Rather than late respondents having low mobility, as reflected by their low trip rates, it was argued that they may simply be reporting low mobility (by omitting trips) or perhaps selecting a travel day on which they actually made fewer trips. Under these conditions, assuming that non-respondents have low trips rates (like the late respondents) may be considerably in error and lead to non-response corrections in the wrong direction.

Data Analysis

Apart from the workshop on Modeler's' Needs, relatively little time was spent discussing the specific types of analyses that might be performed on travel data (more time is likely to be spent on these topics within IATBR Conferences). However, two issues did emerge. Firstly, it was considered that the quality of demand data, and associated analysis, emerging from current travel and activity surveys should be balanced by an improvement in the quality of supply data, and associated analyses, describing the physical transport and land-use systems. The emergence of GIS descriptions of transport networks was seen as a major opportunity in this area. Secondly, it was considered that the considerable attention being paid to measuring travel behavior of people should be complemented by the measurement, and analysis, of the travel behavior of freight and commercial vehicles. Only in this way could a complete description of travel patterns be obtained.

Presentation of Results

Having collected travel behavior data, it was considered essential that it be presented to the various clients in an appropriate fashion. As a general conclusion in this area, it was felt that one could do little better than to buy Tufte's classic books on the presentation of quantitative data (Tufte 1983, 1990, 1997), and then try to live up to the principles he enunciates therein. In addition, considerable discussion took place on the merits of using the Internet as a medium for presenting the results of travel behavior surveys to a wide range of interested parties.

Tidying-Up

Finally, the topic of Tidying-Up at the completion of the survey received more than its normal share of attention. Five major topics emerged in this area. Firstly, proposals for the archival of data sets were discussed including a central clearinghouse for data sets available for secondary analysis. Secondly, issues of data distribution methods and related topics of privacy were discussed in the light of the greater degree of privatization of the data collection function. Thirdly, the idea of providing feedback to respondents, in the form of summaries of results, was raised as a means of sustaining a high degree of cooperation between respondent base and the survey organization. Fourthly, the concept of conducting meta-analyses of travel surveys was suggested as a means of determining what strategies appear to work in increasing response rates and data quality (Kalfs et al., 1997).

Finally, the most over-riding conclusion of the entire conference dealt with the need to document all stages of the survey process. In one way or another, the chairs of all twelve workshops reported on the absolute need to improve documentation standards within their area of interest. Such a recommendation accorded nicely with the theme of one of the Keynote Addresses on Survey Quality, wherein the application of ISO9001 quality standards to travel surveys was suggested (Richardson, 1997), since one definition of the processes involved in ISO9001 (Taormina, 1996) is:

- Write down what you do
- Do what you write down

- Verify the results

If an adherence to these three rules were all that came out of the Grainau Conference, then the conference will have gone a long way to achieving its objective of Raising the Quality of Transport Surveys.

Conclusions

While the Grainau conference had an objective of developing a short (30-page) set of industry "guidelines", and had two keynote papers (Richardson 1997; Pisarski, 1997) and one resource paper (Kalfs et al., 1997) devoted to the topic of quality and guidelines, the final conclusion was that it was not possible to develop such guidelines. This conclusion was based partly on the continuing differences in practice in different countries, but mainly on the fact that it would be impossible to summarize state-of-the art practice in such a short document. In the past five years, there have been several major texts on travel survey methodology (Richardson, Ampt and Meyburg, 1995; Stopher and Metcalf, 1996; Cambridge Systematics and Barton Aschman (1996)) and to attempt to summarize these in 30 pages would give a misleading impression of simplicity to the task of survey design. It would be like attempting to summarize choice modeling in 30 pages. Nonetheless, arising out of the Grainau Conference, the following issues were seen as being the major current topics of debate in the measurement of travel behavior:

- The need for consistent terminology
- Increased use of Total Design approaches
- Activity-based versus Trip-based recording
- Sampling Bias is more important than Sampling Error
- The need to reduce respondent burden
- The need to calculate response rates in a consistent fashion
- The need to find out more about non-respondents
- The increasing use of Geocoding
- The use of imputation methods for missing data
- The need for comparable data on freight and commercial vehicle travel
- Internet applications for travel survey data
- The absolute need for better documentation of survey methods

Paying increased attention to the above issues over the coming years will help lead towards the improved practice that was originally sought by the conference in the development of industry guidelines.

References

Ampt ES (1997). Respondent Burden: Understanding the People we Survey!. Presented at an International Conference on Transport Survey Quality and Innovation, Grainau, Germany.

Arentze T, Timmermans H, Hofman F & Kalfs N (1997). Data Needs, Data Collection and Data Quality Requirements of Activity-Based Transport Demand Models. Presented at an International Conference on Transport Survey Quality and Innovation, Grainau, Germany.

Armoogum, J & Madre J-L (1997). Item Sampling, Weighting and Nonresponse. Presented at an International Conference on Transport Survey Quality and Innovation, Grainau, Germany.

Axhausen ref, 199?

Cambridge Systematics and Barton Aschman (1996). Travel Survey Manual. Prepared for the US Department of Transportation, Washington DC.

Dillman DA (1978). *Mail and Telephone Surveys, The Total Design Method*. John Wiley & Sons: New York.

Freeth S (1997). *Using a Range of Methods to Collect Travel Data: the Experience of the British National Travel Survey*. Presented at an International Conference on Transport Survey Quality and Innovation, Grainau, Germany.

Goulias KG (1997). *Multi-Method and Multi-Instrument Surveys*. Presented at an International Conference on Transport Survey Quality and Innovation, Grainau, Germany.

Grosvenor T (1997). *Qualitative Research in the Transport Sector*. Presented at an International Conference on Transport Survey Quality and Innovation, Grainau, Germany.

Kalfs N, Meurs H & Saris W (1997). *Quality Indicators*. Presented at an International Conference on Transport Survey Quality and Innovation, Grainau, Germany.

Lee-Gosselin M (1997). *Hypothetical Situations*. Presented at an International Conference on Transport Survey Quality and Innovation, Grainau, Germany.

Pendyala RM & Pas IE (1997). *Multiday and Multiperiod Data for Travel Demand Analysis and Modeling*. Presented at an International Conference on Transport Survey Quality and Innovation, Grainau, Germany.

Pisarski AE (1997). *Recognizing, Creating and Marketing Survey Quality*. Presented at an International Conference on Transport Survey Quality and Innovation, Grainau, Germany.

Richardson AJ (1997). *Guidelines for Quality Assurance in Travel and Activity Surveys*. Keynote Paper at an International Conference on Transport Survey Quality and Innovation, Grainau, Germany.

Richardson AJ & Battellino H (1997). *Similar, yet Different: some Emerging Trends in Travel Surveys in Australia*. Presented at an International Conference on Transport Survey Quality and Innovation, Grainau, Germany.

Richardson AJ, Ampt ES & Meyburg AH (1995). *Survey Methods for Transport Planning*. Eucalyptus Press: Melbourne.

Richardson AJ, Ampt ES & Meyburg AH (1996). *Nonresponse Issues in Household Travel Surveys*. TRB Conference on Household Travel Surveys: New Concepts and Research Needs, 79-114.

Stopher PR & Metcalf HMA (1996). *Synthesis on Household Travel Survey Methods*. NCHRP Synthesis Report 236, Transportation Research Board, Washington DC.

Taormina T (1996). *Virtual Leadership and the ISO9000 Imperative*. Prentice-Hall: Upper Saddle River, NJ.

Tufte ER (1983). *The Visual Display of Quantitative Information*. Graphics Press: Cheshire, Connecticut.

Tufte ER (1990). *Envisioning Information*. Graphics Press: Cheshire, Connecticut.

Tufte ER (1997). *Visual Explanations*. Graphics Press: Cheshire, Connecticut.

van der Reis, P (1997). Transportation Surveys among Illiterate and Semiliterate Households in South Africa. Presented at an International Conference on Transport Survey Quality and Innovation, Grainau, Germany.

Zmud, JP & Arce CH (1997). Item Nonresponse in Travel Surveys: Causes and Solutions. Presented at an International Conference on Transport Survey Quality and Innovation, Grainau, Germany.