

Travel Surveys – Review of international survey methods

Christina Inbakaran, Annette Kroen

Department of Transport, 121 Exhibition Street, Melbourne, VIC, 3000

Email for correspondence: christina.inbakaran@transport.vic.gov.au

Abstract

The paper investigates travel survey methods in Australia, and in particular Melbourne, and considers the applicability of methods used elsewhere as well as their potential to improve response rates and data quality. In Australian capital cities travel surveys are either conducted as face-to-face interviews with travel diaries or as self-completion questionnaires which are personally dropped off. As there are different advantages and disadvantages with different methods of conducting survey methods and new technologies have developed in recent years, this paper explores the experiences in other cities and countries and the lessons learned in these areas. In particular the research has looked at experiences with telephone and internet surveys and with using Global Positioning System (GPS) devices. Areas/countries reviewed are Toronto, Chicago and Germany. These areas have had different experiences with the methods mentioned. After exploring their experiences, it will be assessed to what extent these methods could be applied to Melbourne. Overall, the review shows that there is not the one perfect method and the advantages and disadvantages of the different methods with regard to representativeness, response rates, data accuracy and costs have to be weighed against each other. Furthermore, it can be seen that the sampling method in Melbourne is quite effective, while the response rates could potentially be improved through a larger mix of methods, such as using the internet and telephone for data collection. This mix of methods may offer the opportunity to reach different demographic groups and avoid underrepresentation of certain groups.

1. Introduction

Travel surveys have been around since the 1950s. The aim is to collect data which represents as accurately as possible the travel behaviour of the population of an area and understand travel patterns to inform transport and land-use planning decisions. In the 1950s and 1960s travel surveys were mainly conducted in the larger urban areas in the US and some major cities in other countries, such as for example Melbourne in 1951 (MMBW 1951). Those surveys were undertaken as 'Home Interviews' where interviewers would visit households (unannounced) and would ask them about travel on the previous day and demographic information (Stopher 2008).

Over the years, in many countries the face-to-face home interviews have been replaced by other types of surveys, such as mail-out/mail-back; personal delivery/pick up; mail-out/telephone retrieval and telephone only surveys. Recently, some countries and regions have also started to use a mix of mail-out, telephone and internet surveys. Additionally, there are different methods of recruitment of participants such as via telephone, face-to-face and mail (Stopher 2008; van Evert et al. 2006). In Australian capital cities travel surveys are either conducted as face-to-face interviews with travel diaries or as self-completion questionnaires which are personally dropped off.

Main reasons for changes in survey and recruitment methods have been issues with response rates, coding, the accuracy of data as well as the costs of running the survey. For example, the unannounced home interviews often brought unreliable data as interviewees did not remember their journeys accurately. As well, in some regions the mail-back option has been changed to a collection of the data via telephone because response rates were too low. Furthermore, telephone surveys are generally more cost-efficient than home interviews

or mail-back surveys, for example because of better response rates which imply fewer work hours to collect the data. However, not only the response rates are important, but also the 'right' mix of participants, meaning their representativeness of the study area. Recruitment is often one of the difficult aspects of surveys as in many countries no listing of household addresses are publicly (or privately) available which makes random sampling difficult.

This paper will therefore concentrate on the potential of certain survey and recruitment methods to deliver higher response rates and accuracy of data. For this it starts with a brief overview of traditional and new approaches and their potential advantages and disadvantages. Subsequently, it briefly explores methods used in Australia and in particular the Victorian Integrated Survey of Travel and Activity (VISTA). The following section then looks at city regions and countries which have changed their methods recently and have used technologies different to VISTA. Afterwards, it will be assessed to what extent these methods could be applied to Melbourne, what this would mean with regard to financial aspects as well as response rates and sample sizes and which other matters have to be taken into account. Finally, it will be discussed whether it would be advantageous to use different methods for different demographics or areas, such as regional and urban areas.

2. Context: different approaches and survey design

As mentioned different approaches to survey design have different advantages and disadvantages regarding response rates and accuracy of data. This section will give a brief overview of the most common survey approaches with regard to their disadvantages and advantages.

2.1 Traditional approaches

2.1.1 Face-to-face interviews and self-administered surveys

Travel surveys started as face-to-face interviews. This meant that the interviewer 'visited' the participant at home and conducted the interview personally. This type of survey allows for direct interaction between the interviewer and participant and with this for the opportunity to explain questions, to ensure responses are understood correctly as well as to validate answers immediately. The main disadvantage of this survey type is that it requires much time and personnel input and high costs (van Evert et al. 2006). A further difficulty is the appropriateness and safety of a home visit. For example, in the US the home interviews were replaced by other survey types because it was perceived that it was not safe to carry out interviews in certain parts of the study areas (Stopher 2008).

Self-administered surveys are questionnaires which are handed out to the participants and in general have to be filled out for travel on a specified date. Instead of the questions being asked by an interviewer the respondent completes the questionnaire. The advantage of this survey type is that the respondents can fill in the questionnaire in their own time and that less costs for personnel are generated. Furthermore, this type of survey has reached a high degree of standardisation. The disadvantage is that there is a higher probability of wrong responses due to misunderstanding. The response rate of self-administered surveys depends on how the questionnaires are collected which is either through mail-back or pick-up, but also on additional activities, such as telephone motivation calls, telephone hotlines for comprehension questions etc. (van Evert et al. 2006).

2.1.2 Telephone surveys and recruitment

Telephone surveys are particularly useful in countries with a high proportion of people with telephones and also where samples cannot be drawn from other sources, such as the municipal registries or equivalent census databases. Several countries, such as the US, Canada and Germany, have used the telephone as main approach to contact people, and to collect the data, for decades.

However, many surveys using the telephone for data retrieval and/or recruitment are experiencing an ongoing reduction in response rates. Several reasons have been cited for that, such as the decreasing numbers of people being listed in telephone registries, the increase in people using caller identification and answering machines, unlisted phone numbers, people using only a mobile phone as well as tele-marketing. The increase in tele-marketing has led to people being less willing to be recruited to surveys on the phone and also being more cautious with giving out personal information. It has also led to the establishment of so-called 'Do Not Call' registers (ACMA 2011). Even though travel surveys are often not subject to the do not call registers, people still do not want to be called for surveys.

A further disadvantage of samples drawn from published telephone registries is that unlisted numbers are excluded from the sample which can skew the representativeness of the sample (van Evert et al. 2006). This issue is of increasing concern as households with unlisted numbers represent an increasing proportion of the population and certain population groups are more likely to have an unlisted number (Dal Grande et al. 2005). Related to this is the increasing usage of mobile phones as only phone connection. Mobile phone numbers are less often registered in public telephone lists, and in Australia are not listed at all, so people that do only have a mobile are less likely to be contacted for a survey (ACIF 2000). Additionally, mobile phone numbers do not necessarily give information on where people live and therefore make it difficult to draw a sample that is geographically useful. This adds further bias to the use of telephone as first contact method.

2.2 New approaches

2.2.1 Internet surveys

Giving participants the possibility to respond to surveys via internet has been discussed in several regions as a means to reach households which are otherwise underrepresented, such as for example younger single persons who often do not have a land line number (Data Management Group 2010, Stopher 2008). However, the sole use of the internet is currently not considered as this would reduce the representativeness of the survey, as a large proportion of households does not have internet at home. For example in Australia the number of households with access to internet at home lies at 72 %, with differences throughout the states and territories. In Tasmania, the state with the lowest percentage, 63 % of households have internet access at home, while the Australian Capital Territory has the highest percentage with 82 %. In the State of Victoria 72% of the households have internet access at home. A further difference can be found between metropolitan and ex-metropolitan areas 76 % and 65 % respectively connected to the internet at home (ABS 2009).

Furthermore, it may be possible that questionnaires are not filled in correctly as people fill them out on their own with no direct instruction or contact to ask if there are uncertainties. Where internet surveys are used this problem is tried to be countered by giving phone numbers and websites people can call or access when they have questions. Overall, the role of internet surveys in the near future is likely to be that of an addition to other survey modes rather than that of a method to use for representative travel surveys.

2.2.2 GPS devices and mobile phones

The technological development of mobile technologies, such as mobile telephones and Global Positioning System (GPS) devices, is providing a new possibility for undertaking surveys about travel. While GPS devices do not have a strong influence on the recruitment of households they have the potential to improve the accuracy and depth of spatial and temporal data of household travel surveys. The first GPS surveys have been undertaken in the mid 1990s, mainly to identify the characteristics and the extent of trip under-reporting (Kracht 2006). Currently, GPS devices are still mostly used as an additional method for

traditional surveys and usually with just a proportion of all respondents, in order to measure the accuracy of the trips reported and the extent of trips not reported. One reason for the deployment to only a restricted number of households has been the cost of the devices which made it too expensive to deploy them to the whole study sample. However, as equipments costs have decreased and first experiences been collected, there are studies underway attempting to develop methods for GPS only surveys (Bricka 2008).

The advantage of GPS devices is that more precise travel times, distances and route information can be obtained, as well as vehicle operation characteristics. Also, advances in travel-demand modelling require more detailed information about travel behaviour which can be covered with GPS devices relatively easy while it is difficult to get this information from households directly. While the passive data collection through GPS devices do not require participants to fill out travel diaries can therefore more easily be run for longer periods of time, there is still some 'work' involved on the side of the respondent which influences the quality of the data or might be too much for people to consider participating. This includes the logistics of deployment as well as the fact that participants need to remember to carry and recharge the devices. Examples have been cited where respondents did not carry the device all the time, because it had to be recharged or because it was too bulky (Swann & Stopher 2008). This creates issues with the correct recording of all travel. However, new devices are getting smaller and have also improved power efficiency. A further issue with GPS devices are privacy issues and it is likely that a few people might rather not participate in GPS surveys as they do not want their movements tracked. This could influence response rates negatively.

The usage of mobile phones in travel surveys is actually one aspect of GPS studies as GPS-equipped mobile phones are used. The numbers of surveys using mobile phones has been relatively low so far. For example studies in Japan used a mobile active logger and had respondents logging departure and arrival times, as well as mode changes in a web diary (Bricka 2008). The advantage of using mobile phones is the immediate transmission of data and the possibility of using devices of respondents without the need for deployment. A disadvantage could be issues with coverage and respondents not logging all data.

3. Travel surveys in Australia

This section gives a brief overview of approaches to travel surveys in Australia and explores the Victorian Integrated Survey of Travel and Activity (VISTA) in more detail, in order to be able to assess the applicability of new methods to Victoria later in the text.

3.1 The Victorian Integrated Survey of Travel and Activity (VISTA) – Melbourne

The Victorian Integrated Survey of Travel and Activity (VISTA) has been conducted in the financial years 2007/08 and 2009/10 and collected information from households in Melbourne, Geelong and the regional centres of Ballarat, Bendigo, Shepparton and Latrobe. VISTA uses a self-completion questionnaire which is hand-delivered to and also collected from the participating households. Of a participating household all members have to complete the travel diary for a specified day. As VISTA is conducted every day over a whole year it is possible to find out seasonal changes of travel. It also means that it takes a year until all data is collected (DOT 2009).

The sample consists of about 10,000 households for the Melbourne Statistical Division¹ and 6,000 for the remainder of the study area. The sample is drawn from a GIS database of

¹ Statistical Divisions are defined areas which represent large, general purpose, regional type geographic areas. They represent relatively homogenous regions characterised by identifiable social and economic links between inhabitants as well as economic units within the region (ABS 2011).

cadastre blocks within residential areas. First a sample of Census Collection Districts² is randomly selected and within the districts households are randomly selected (TUTI & I-view 2011). After the sample addresses have been checked to be suitable and before a personal contact is made a letter is placed in the mailbox with a pre-contact letter and a survey brochure. The personal contact then takes place on the following weekend when field staff deliver the questionnaires. If no contact can be made the survey materials will be left in the mailbox. A week later the filled in questionnaires will be picked up again at an agreed time, or if this is not possible, from an agreed location (such as the mailbox). Overall 61 % of the questionnaires are delivered personally to the householder. Furthermore, households receive a reminder call on the specified day of travel which also offers the possibility to clarify potential questions (Ampt et al. 2008, TUTI & I-view 2011).

As soon as the questionnaires are collected the data entry and data editing starts. This allows following up unclear or incorrect forms as soon as possible by calling the respective household. Households where it was not possible to collect the forms will be reminded via phone call or letter to return the questionnaire if they have completed it. The response rate of the survey lies at 47 %, from the eligible households (Ampt et al. 2008, TUTI & I-view 2011).

VISTA 2007 also included a small pilot survey of wearable GPS devices combined with the travel diary (190 respondents). Results of the survey were ambiguous with 45 % of the respondents reporting trips that were also picked up by the GPS devices, and the remainder being a combination of GPS devices not recording the trips (e.g. because the device had not been carried), different trips measured by GPS device and reported in the travel diaries and also some refusals of completing the survey. However, as can be seen later for the Chicago travel survey, these numbers are not unusual. A further GPS study was not conducted as part of the 2009/10 VISTA survey as the diary methodology was considered appropriate for the data needs of the Department, and provided a consistent dataset for comparison with the 2007 survey. The additional project costs required for a GPS inclusion, combined with the response rate obtained (just 30% of households participating in VISTA also accepted the GPS device) and lack of larger scale application in Australia, also contributed to the decision not to expand the earlier GPS trial (TUTI & I-view 2011; pers. comm. Roddis 2011).

A cut-down online version of VISTA is currently being tested as part of the Victorian Government's Electric Vehicle Trial to monitor participant travel behaviour before, during and after the trial. The survey will not necessarily offer information about response rates (as all participants are expected to complete this survey) but will assist in determining the comparability and accuracy of an online data collection approach in Victoria. It is expected that the survey will be used to gather a week of travel data at a time.

Before VISTA, a similar survey had been conducted continuously from 1994 to 2002 by the Transport Research Centre at RMIT University called the Victorian Activity & Travel Survey (VATS). In 2000 major changes were made to the design which made the comparison to the years before difficult. Furthermore, there were problems with the quality of data and documentation as some components had been outsourced to market research companies. For these and other reasons the survey was terminated after 2002. The main difference to the VISTA survey are that VATS was a mail-out/mail-back survey; the sample was drawn from the Electronic white pages; the survey was conducted continuously; about 5,000 households per year participated; the study area was the Melbourne metropolitan area only; and the survey was conducted outside of Government and data was sold to users (Ampt et al. 2008, TUTI & I-view 2011).

² Census Collection Districts (CD) are designed for use in the Census of Population and Housing as the smallest unit for collection and processing (ABS 2011).

3.2 Other Australian travel surveys

There have been several travel surveys in other metropolitan areas in Australia. The main important difference between them is whether face-to-face interviews or self-completion questionnaires are used. It has to be noted that none of those travel surveys has used the telephone for recruitment or data retrieval. Of course there are further differences with regard to areas covered, when the survey was undertaken, the number of participants etc. These differences are captured in table 1 which gives an overview of the travel surveys undertaken.

Table 1: Overview of Travel Surveys in Australian metropolitan areas

	Melbourne	Sydney	South East Queensland	Adelaide	Hobart
Name	Victorian Integrated Survey of Travel and Activity (VISTA)	Sydney Household Travel Survey (HTS)	South East Queensland Travel Survey (SEQTS)	Metropolitan Adelaide Household Travel Survey (MAHTS)	Greater Hobart Household Travel Survey
Area covered	Melbourne Stat. Division, Geelong; Ballarat, Bendigo, Shepparton. Latrobe	Sydney Greater Metropolitan Area	Brisbane, Gold Coast and Sunshine Coast Statistical Divisions	Adelaide Statistical Division	Greater Hobart Area
Year	2007/08 & 2009/10	Continuously since 1997	2003/2004, 2006-2008, 2009	1999	2008/2009
Days covered	Every day of the year	Every day of the year	<i>Not known at time of writing</i>	Every day of the week (not for school holidays)	Every day of the year
Number of households	17,100 in 2007/08	9,500 from 07/2006 to 06/2009	10,000 in 2009	5,600	2,400
Survey type	Self-completion questionnaire (delivered/picked up)	Face-to-face interviews	Self-completion questionnaire (delivered/picked up)	Face-to-face interviews	Self-completion questionnaire (delivered/picked up)
Sample	Drawn from cadastre blocks and randomly selected collector districts	Dwellings randomly selected in a random collector district in each travel zone	Drawn from a random selection of collector districts	Drawn randomly by the State Electoral Commission from the State Electoral Roll	Drawn from a random selection of collector districts
Previous surveys	1994-2002	1971, 1981, 1991/92	1992	1986	

Sources: Inbakaran & van der Klooster 2009; Queensland Government 2011; Transport NSW 2010; Stopher et al. 2002; DIER 2010; DOT 2011; DOT 2009; pers. comm. Oxlad 2011

4 Travel surveys in selected international cities and countries

As described previously, there are a number of new approaches to travel survey design which could be of interest for travel surveys in Australia. In order to understand better the characteristics of those approaches the following section describes the experiences in cities and countries which have changed their methods recently and have used or are planning to use telephone and internet surveys as well as GPS devices. Telephone surveys are included here, even though they are not a new approach, as in Australia they have not been used so far. The surveys that are reviewed are the Toronto 'Transportation Tomorrow Survey', the Chicago 'Regional Household Travel Inventory' and the 'Mobility in Germany' survey. These surveys have been selected because they have used at least one of the methods mentioned, have relatively large samples (representativeness) and because experiences as well as advantages and disadvantages were reviewed and documented. Table 2 gives an overview of methods, sample etc. used in the case studies. After exploring the lessons learned, the following section will assess to what extent these methods could be applied to Melbourne.

4.1 Toronto

The Transportation Tomorrow Survey (TTS) is conducted every five years with the first survey being undertaken in 1986. The areas included into the TTS have differed from year to year. The first TTS covered the Greater Toronto Area, while the next survey was an update focusing primarily on those geographic areas that had experienced high growth since 1986.

In 1996 the survey structure changed and the survey area was expanded considerably outside the Greater Hamilton Toronto Area. For the 2001 and 2006 surveys individual municipalities have been included and excluded, but overall the study area has remained the same. The 2006 TTS was undertaken by 21 local and provincial government agencies³. The target was to interview a 5% sample of households based on the number of households reported in the national census. This translates into approximately 115,000 to 150,000 interviews for each survey (Data Management Group 2010).

The Transportation Tomorrow Survey is conducted as a telephone interview with direct data entry. The participants are selected from the standard telephone directory. As it has been found that households are more likely to participate in the survey, when they have heard about it before, letters explaining the survey are sent out and further channels of information are used to make the survey known, such as information of local government and public service officials are informed and a press release for newspapers, television and radio stations in the survey area. The receipt of advance letter significantly reduces the refusal rate, probably by about 15% (Data Management Group 2010). Households are asked to do the survey on the phone and not fill in a questionnaire.

In 2006 the response rate of all households contacted was 45% and in 2001 64%. Reasons for this decline in response rate and an increase in phone calls needed to complete an interview are seen in the increasing number of households without conventional telephone service as well as the use of call screening. As mobile phones are not listed in the telephone directory listings that are used for the TTS, households which do have a mobile phone only do not go into the sample for the survey. This is thought to explain why there is a growing trend for young people in the work force as well as for post-secondary students to be underrepresented in the results. Another group that is underrepresented in the survey is apartment dwellers. The cause for this is seen in the fact that residents of apartment buildings are less likely to receive the advance letter, due to the exclusion of apartment numbers from the address information. These issues have has triggered some rethinking

³ Membership of the committee includes the Cities of Toronto and Hamilton, the Regional Municipalities of Durham, York, Peel, Halton, the Toronto Transit Commission, GO Transit and the Ontario Ministry of Transportation.

about survey methods and sampling and led to the suggestion to include online surveys into the next TTS, in particular to reach post-secondary students. Furthermore, it is suggested to use a different sample source, for example from the Municipal Property Assessment Corporation, which contains the complete address with unit numbers. This could be matched with the telephone directory to call households, while households that cannot be matched with a telephone number would receive a letter with a request to complete a survey either by calling in or via the internet (Data Management Group 2010).

As the telephone survey with direct data entry is seen as the most reliable and cost-effective method and for comparability reasons it is likely that this method will also be used in the next TTS. However, it is also very likely that online surveys and the different sampling of households will be included additionally, in order to achieve higher response rates. Possibly the decision will depend on the costs of developing the online component and the mail only component (Data Management Group 2010).

4.2 Chicago

The most recent Chicago Regional Household Travel Inventory – also known as Travel Tracker Survey – has been conducted between January 2007 and February 2008; the last survey before this was in 1990. The area covered by the survey is the Greater Chicago Area⁴ and it has been conducted on behalf of the Chicago Metropolitan Agency for Planning (CMAP). A total of 10,552 households participated in either a 1-day or 2-day survey (CMAP 2011).

The Travel Tracker Survey uses a mix of telephone and mail contact. Households are selected from the general telephone directory. CMAP states that the distribution of the sampled population closely matches the region's household population by county. However, only people with landlines could be reached as mobile numbers are not included in the used listing. For recruitment households are contacted via mail and can send the screening questionnaire back via mail or answer it over the phone. The travel diary is then also sent out by mail, but the data collection takes place over the phone.

The survey included a GPS sub-sample with the use of in-vehicle GPS devices and also of wearable GPS devices. Objectives of this sub-sample were to identify the types of trips underreported, the characteristics of households or individuals associated with not-reported trips as well as to provide additional travel behaviour details (Wolf & Lee 2008). Respondents were asked to participate in the GPS part of the survey when during the recruitment call they reported a high frequency of trips or long distance trips (in-vehicle GPS) or walk, bike, or public transport trips (wearable GPS). 300 households participated in the study with an in-vehicle GPS device and 147 households participated in the study with a wearable GPS device (Bricka & Wolf n.d.).

If households agreed to participate in the GPS study they were called again from the field deployment team to establish a date for the delivery of the GPS device. This call also served the purpose to ensure that households understood what the GPS component involves and to confirm their interest in participating. Once an appointment had been made the GPS instruments for cars were brought and picked up on an agreed date, while the wearable GPS devices were mailed out. The households also had to keep a travel diary and to report their travel back to a phone interviewer in order to be able to compare the data with the GPS trip data to identify levels of under-reporting.

The overall response rate for the survey is given as between 10 and 29% (NuStats n.d.). In more detail this means that 53% of the eligible households contacted agreed to participate in

⁴ The study area is defined as Cook, DuPage, Grundy, Kane, Kendall, Lake, McHenry, and Will Counties (all in Illinois).

the study and of those households 55% completed the study (retrieval rate) (NuStats n.d.). For the GPS study GPS data and travel diary data could be collected for 57% of the households to which an in-vehicle device had been deployed and for 48 % of the households to which a wearable GPS device had been deployed. For the remaining households either GPS data was not recorded correctly, e.g. because of wrong installation, or the travel diary information could not be collected. There was also a low percentage of households who first agreed to participate in the GPS study, but did refuse later on (Bricka & Wolf n.d.).

Overall the results of the GPS study showed that most participants had reported their trips correctly. In the in-vehicle study 64 % of households and 45 % of persons participating in the wearable GPS had not missed any trips. The numbers of non-reported trips were relatively low with 46 and 24 trips respectively that should have been reported in the travel diary. The main reason given for non-reporting was that participants had forgotten about the stop. These stops included for example drop-off or pick-up of people, getting food, mailing letters, shopping stops and visiting friends (Bricka & Wolf n.d.). Even though there were no particularly high numbers of under-reported trips the collection of GPS data was considered as useful and worth the additional costs of including GPS devices into survey. However, it was recommended to consider the mailing out and back of wearable GPS devices as a higher number than anticipated was lost and mainly due to respondents not sending the device back. Therefore, it was suggested to consider deploying these devices in-person as well, like the in-vehicle ones (Bricka & Wolf n.d.).

4.3 Germany

‘Mobility in Germany’ (Mobilität in Deutschland) is a national travel survey of about 50,000 households. It has been conducted for the first time in 2002 and again in 2008. Similar surveys have been conducted in 1976, 1982 and 1989 under the name ‘KONTIV’ (Kontinuierliche Erhebung zum Verkehrsverhalten). However, there exist some differences in recruitment and questionnaires, and therefore KONTIV and Mobility in Germany are not entirely comparable (Kunert & Follmer 2005).

The 2008 survey used a method mix of written, telephone and online interviews. While telephone was the main method for data collection, the possibility to respond to parts of the interview online was included for the first time, in order to increase the potential accessibility of all households in Germany to the survey. The random sample for the survey is based on municipal population registers and comprises the resident population of Germany from zero years onwards. The population register contains names, address, gender, age and nationality, but no phone numbers. This makes it necessary to find out phone numbers through a matching process, for which the matching quote was about 55% in 2008 (Infas & DLR 2010).

The Mobility in Germany survey had two phases: in the first phase the household structure, available vehicles and some further characteristics were collected; For the first phase all households received a letter in which the aims and the procedure of the travel survey were explained. Households where no phone number had been matched the letter also contained the first phase questionnaire which could be filled out and sent back. These households were also asked for their phone number. Households where a phone number was available were called to collect the data. Additionally, all households also received information and access codes for using the online questionnaire. Thus, the first phase questionnaire could be answered in written form, via the phone or online.

For the second phase all household members were asked about their trips on a certain date and about some personal characteristics. The responses for the second phase were only collected via phone interviews. The main reason for this decision was the good experience with higher response rates and better data quality via phone interviews in the 2002 survey, possibly due to personal contact and the possibility to prompt for trips and information (Infas

& DLR 2010). Each household member had to fill in a travel diary for the appointed date. Afterwards the household was called in order to conduct the actual interview about trips taken and personal characteristics with each household member.

The return rate of the survey – meaning the questionnaires which could be used for the final data sets – was 21% which was lower than in 2002. In particular, households where phone numbers were not available from the start had a low return rate of 5%; despite a good uptake of the internet option for the first phase. For the households which were contacted via phone in the first phase the return rate was 35%. In 2002 this rate was 53%. The main reason for this lower return rate is seen in the high volume of marketing calls which leads to many households refusing any sort of survey. As it seems that households for which no phone number can be matched are not statistically different to households with phone numbers, it is suggested that the effort put into getting households without phone number to respond is not necessarily worth it (Infas & DLR 2010). Therefore, potentially this step will be changed in a future survey.

Even though the internet option had a good uptake, the overall return rate of households where no phone number was available was much lower. However, this has probably not to do with the internet option, but rather with those households not registering their phone number or other reasons. The 2002 survey had also shown that the response rate and data quality of phone interviews was better than the written form. Nevertheless, it is stated in the methods report that the different access methods are crucial and should not be omitted. The online access is seen as an important component and it is recommended to expand it to the second phase of the actual travel diary. However, it is acknowledged that this will involve thorough preparation of the online design. Furthermore, it is suggested to add personal interviews to the mix of methods, in order to secure and increase the response rate (Infas & DLR 2010).

Table 2: Overview of Travel Surveys in the case studies

	Toronto	Chicago	Germany
Name	Transportation Tomorrow Survey (TTS)	Chicago Regional Household Travel Inventory	'Mobility in Germany' (Mobilität in Deutschland)
Area covered	Different areas in different years; from 1996: GTHA + differing municipalities	Greater Chicago Area	Germany
Year	1986, 1991, 1996, 2001, 2006	2007/2008	2002, 2008
Days covered	Only weekdays	Every day of the week	Every day of the week
Number of households	115,000 – 150,000 people	10,552	50,000
Survey type	Telephone interview	Telephone interview with travel diary; GPS sub-sample also with travel diary	Tel. interview with travel diary; screening questionnaire: mail-back, phone interview or online
Sample	Selected from the standard telephone directory	Selected from general telephone directory	Selected from the municipal population registers
Previous surveys		1990	1976, 1982, 1989

Source: Own summary

5 Applicability to Victoria

The experiences in the case studies show that telephone and internet surveys as well as GPS studies have certain advantages, but also some disadvantages. Crucial issues for the decision whether to apply any of those methods are the response rate, the representativeness of the survey sample, the data accuracy as well as the costs. In order to assess the applicability to Victoria the next section will consider these issues and how they have influenced the surveys in the reviewed areas.

The sampling methods used in the examples were a selection from the standard telephone directory and a selection from municipal population registers. In Toronto it has also been suggested to change from the telephone directory to another source which contains complete addresses with unit numbers, such as from the Municipal Property Assessment Corporation. The sampling from the telephone directories has the disadvantage that mobile phone numbers were not listed and in Toronto it was argued that this is a reason why young people in the work force and post-secondary students are underrepresented in the results. The selection from the municipal population registers has the disadvantage that no phone numbers were listed and it was necessary to match the selected addresses with phone numbers. However, for the German survey it was said that the households where no phone number could be matched did not seem to be statistically different. Furthermore, if the survey is not conducted via phone this does not matter. The geographical clustering that is used in Victoria has the advantage of getting a geographically representative sample; however the sample is not demographically representative which needs to be taken into account when analysing the data. Therefore, using municipal population registers or similar information for sampling would be advantageous in Australia. However, it might prove difficult to access such information, as in Australia there are no municipal population registers. Information from the Australian Tax Office could possibly be used, but would depend on privacy issues.

For Toronto the response rates of all households contacted lay by 45% and in Chicago it was between 10 and 29 %. In Germany, only the return rate has been published – which counts interviews used for the final data set, so for example omits households where less than half of the members could be interviewed. The return rate of all households has been 21%, so it was quite low. However, the return rate for households where the phone number could be matched lay at 35%. Unfortunately, this does not allow drawing any conclusions about advantages of certain methods with regard to response rates, as in all surveys the participants had been sent information beforehand and were then asked on the phone. However, the results suggest that telephone interviews have a better response rates than mail-back surveys, one of the reasons why telephone interviews have been introduced in the first place. As the uptake of the online questionnaire for the first phase of the Mobility in Germany survey was quite good, while the second phase was telephone interview only, it cannot clearly be said whether online surveys offer a good response rate or not. In comparison, the response rate for VISTA lies at about 47 % so it seems that the personal delivery and pick-up combined with self-completion achieves about the same response rates. In all regions it was observed that personal contact and/or explanation of the survey (such as through personal delivery, phone calls or for the explanation advance letters) improved the response rate whereas mail-out only had lower response rates.

Regarding data accuracy, it has been mentioned that for the German survey that in 2002 data quality had been better for the telephone surveys than for the mail-back surveys. Apart from that the Chicago survey has used GPS devices to detect inaccuracies of data and to record more detailed data. This means that, as mentioned before, telephone interviews – as well as face-to-face interviews – give the opportunity to validate responses immediately and to explain questions, delivering therefore better data. Another way of validating responses is to compare GPS data and responses to the survey. As mentioned previously, GPS data also offer the opportunity to measure more detailed data, such as actual travel time and travel

routes. In comparison, self-completion questionnaires have a greater risk of people underreporting or misunderstanding.

The costs of the different surveys are not publicly available; however for Toronto it has been mentioned that the costs of the development of an online component and of a mail-out only questionnaire in comparison to the costs of more telephone calls or larger survey samples are important factors for deciding whether to use these components or not. In general, it is said that it is more cost-efficient to call people than undertaking face-to-face interviews, delivering questionnaires or sending them out. However, with decreasing response rates telephone surveys, the additional costs of those methods could be justified if they result in higher response rates. Additionally, with online surveys, once an online component has been developed the further costs are not very high, so that this method could also prove more cost-efficient. GPS surveys add the additional costs of the devices as well as more time input into data analysis. Overall, this needs to be analysed and weighed for each specific region.

So what do these results mean for the applicability to Victoria? Would it be feasible to conduct telephone interviews, online surveys or a further GPS study? With regard to telephone surveys, they could potentially be used for data collection as a high percentage of households has telephones, be it land lines or mobile phones. As mentioned before, the advantage would be that responses can be validated immediately. Another issue to take into account is that in a multicultural society like Australia, for some households English is a second language. Stopher (2008) additionally mentions, with regard to the US, the high illiteracy or at least the high number of people with difficulties to read and understand texts. This suggests that phone interviews have the advantage of questions being read out and people not having to read and understand the questionnaire (which can look quite complicated) and also possibly of undertaking the interview in another language. Similar advantages are true for face-to-face interviews, however, telephone interviews are in general less costly. As said before, the decision between the two methods depends on the response rates.

Online surveys would be applicable for Victoria as a supporting method; however, they might prove difficult in regional areas and for older people, because, as mentioned above, the internet access at home in ex-metropolitan areas is lower (65 %) than metropolitan areas (76 %) and also 69 % of people aged 65 and older in Australia did not use the internet from any location in 2008/09, although this trend is declining (ABS 2009). Also, considerations in Toronto, Germany and other areas showed that the internet should only be used as a supporting method. However, even though Toronto has not tried it yet, the internet might be useful to get higher response rates from younger age groups, and maybe also middle age groups; because they use the internet more, but also because filling in a questionnaire by hand might be considered to cumbersome by many of them. Furthermore, an internet form of the questionnaire might be easier to understand than a hard copy.

Surveys with GPS devices can also be applied to Victoria, although there might be problems with the coverage in tall buildings. The usage of mobile phones for surveys could be difficult in rural areas for coverage reasons, as most people do not have a satellite mobile phone, although numbers are increasing and general mobile phone services do cover between 94 and 99 per cent of the Australian population with regard to where people live. Again, it is probably useful to use GPS mainly as a supporting method with additional travel diaries, so that GPS data can be checked against responses and vice versa and response rates of the whole survey are not influenced. As mentioned previously, a small GPS study has been conducted for the VISTA 2007 survey but was not repeated in 2009. Nevertheless, it might still be useful to conduct a further smaller GPS study in order to test the travel diary method once more as results in 2007 had been ambiguous, but also to measure more detailed data, such as actual travel time and travel routes. However, this would be dependent on costs, which should be lower than in 2007 as GPS devices have become less costly in recent years.

Overall, the experiences with the reviewed surveys and also elsewhere suggest that it would be good to try a mixed survey approach of internet and telephone surveys in order to reach different demographics and to avoid problems of illiteracy. However, if it is possible to explain the hard copy diaries to participants when they are dropped off, hard copies can also still be used and households could choose from which way of responding they would prefer. However, it might be cheaper to forego the drop off and pick up of hard copies and send them out instead. This would have the disadvantage of people potentially misunderstanding questionnaires, but could capture demographics that prefer to fill in a hard copy. A mix of methods seems to offer the possibility to retrieve responses from different demographic groups and is recommended.

Regarding the sampling, it seems that the cluster approach currently used in Melbourne, and in other States, is an approach which leads to a higher representativeness than sampling from telephone registries, in particular with regard to geographical representativeness. However, with regard to demographic representativeness it would be more effective to use municipal population registers which give already some information on the household structure and age of participants.

6 Conclusion

Overall, the review of travel survey methods and in particular the methods used in Toronto, Chicago and Germany have shown that there is not the one perfect method, and that the advantages and disadvantages of the different methods with regard to representativeness, response rates, data accuracy and costs have to be weighed against each other. The review has also shown that a mix of methods may be promising to reach different demographic groups and avoid underrepresentation of certain groups.

The comparison of the Victorian travel survey to the other surveys has demonstrated that the sampling method in Melbourne is quite effective, and unless it is possible to use data similar to municipal registers relatively easily, should be continued. The response rates could however potentially be improved through a larger mix of methods, such as using the internet and telephone for data collection. This would potentially offer the advantage that the questionnaire is easier to understand, that population groups with difficulties in understanding or reading English do not need to read the questions themselves, or could read them in their language, and that different age groups and demographics could use their preferred method. As GPS devices offer the opportunity to achieve greater data accuracy they should be tried as a supplement to the next travel survey, in order to check for non-reported trips, but also to obtain more detailed data on travel times and travel routes. This would offer the possibility to weigh the costs of this against the improvement in data; however, experiences in other regions already show that their use is quite successful and that overall costs are sinking as devices are getting less expensive.

The next years will show further improvements in the methods reviewed, but it seems very likely that in the next years, it will be the best option to rely on a mix of methods.

7. References

ABS – Australian Bureau of Statistics (2009) *8146.0 - Household Use of Information Technology, Australia, 2008-09*; Released 16/12/2009; Canberra: ABS

ABS – Australian Bureau of Statistics (2011) *Glossary* available under: <http://www.abs.gov.au/ausstats/abs@.nsf/bb8db737e2af84b8ca2571780015701e/4B6D4A6E729E8275CA25720900078321?opendocument> , last accessed 26/05/2011

ACIF – Australian Communications Industry Forum (2000) *Industry Code: Integrated Public Number Database (IPND) Data Provider, Data User and IPND Manager*, ACIF C555:2000, Milsons Point: ACIF; available under http://www.acma.gov.au/webwr/telcomm/industry_codes/codes/c555.pdf

ACMA – Australian Communications and Media Authority (2011) <http://www.donotcall.gov.au/> ; last accessed 10/05/2011

Ampt, E, de Dios Ortúzar, J and Richardson, A J (2008) *On large scale on-going mobility surveys: The state of practice*, *Paper at the 8th International Conference on Survey Methods in Transport*, Annecy, France

Bricka, S (2008) *Non-Response Challenges in GPS-based Surveys*, *Paper at the 8th International Conference on Survey Methods in Transport*, Annecy, France

Bricka, S and Wolf, J (no date) *Chicago Regional Household Travel Inventory Draft GPS Final Report prepared for Chicago Metropolitan Agency for Planning*, Austin: NuStats

CMAA – Chicago Metropolitan Agency for Planning (2011) <http://www.cmap.illinois.gov/travel-tracker-survey> , last accessed 10/05/2011

Dal Grande, E., A. Taylor, and Wilson, D (2005) *Is there a difference in health estimates between people with listed and unlisted telephone numbers?* *Australian and New Zealand Journal of Public Health*, 29 (5), pp 448-456.

Data Management Group – University of Toronto (2010) *Transportation Tomorrow Survey 2006 – Design and Conduct of the Survey; January 2010*, Toronto: Data Management Group

DIER – Department of Infrastructure, Energy and Resources; Infrastructure Strategy Division (2010) *Greater Hobart Household Travel Survey Summary of analysis and key findings; December 2010*, Hobart: DIER

DOT – Department of Transport (2009) *Victorian Integrated Survey of Travel and Activity 2007*, Melbourne: DOT

DOT – Department of Transport (2011) <http://www.transport.vic.gov.au/vista> , VISTA website Department of Transport, last accessed 09/05/2011

Inbakaran, C and van der Klooster, M L (2009) *Communication and Marketing of a National Time Users Group – e.g. Travel Time*; *Paper at the 31st Conference of the International Association for Time Use Research*, Leuphana University Lüneburg, Germany

Infas and DLR (2010) *Mobilität in Deutschland 2008 Methodenbericht*; Bonn, Berlin: Infas & DLR

Kracht, M (2006) *Using Combined GPS and GSM Tracking Information for Interactive Electronic Questionnaires* pp. 545-560 of Stopher, P and Stecher, C (eds) *Travel Survey Methods: Quality and Future Directions*, Oxford/Amsterdam: Elsevier

Kunert, U and Follmer, Robert (2005) 'Methodological Advances in National Travel Surveys: Mobility in Germany 2002', *Transport Reviews*, 25: 4; pp 415-431

MMBW – Melbourne and Metropolitan Board of Works (1951) Survey of daily movement of people within Greater Melbourne, Melbourne: Opinion Research Centre

NuStats (no date) *Chicago Regional Household Travel Inventory, Draft Final Report*, Prepared for Chicago Metropolitan Agency for Planning

Queensland Government (2011) <http://www.tmr.qld.gov.au/Projects/Name/S/South-East-Queensland-Travel-Survey.aspx>, website Queensland Government; Transport and Main Roads, last accessed 09/05/2011

Stopher, P (2008) The Travel Survey Toolkit: Where To From Here?, Keynote Paper prepared for the *8th International Conference on Survey Methods in Transport*, Annecy, France

Stopher, P, Rose, J and Bullock, P (2002) *Simulated Household Travel Survey Data: Synthetic Data in Australia*, Working Paper ITS-WP-02-12, Sydney: ITS

Swann, N and Stopher, P(2008) Evaluation of a GPS Survey by Means of Focus Groups, *TRB 87th Annual Meeting*, Washington DC: Transportation Research Board

Transport NSW, Transport Data Centre (2010) *2008/09 Household Travel Survey Summary Report 2010 Release*; REPORT 2010/01, JUNE 2010; Sydney: Transport NSW

TUTI (The Urban Transport Institute) and I-View Pty Ltd (2011) Victorian Integrated Survey of Travel & Activity 2007-08 – Survey Procedures and Documentation v1.4; 11 February 2011, Melbourne

Van Evert, H, Brög, W and Erl, E (2006) Survey Design: the past, the present and the future, pp 75-93 of Stopher, P and Stecher, C (eds) *Travel Survey Methods: Quality and Future Directions*, Oxford/Amsterdam: Elsevier

Wolf, J and Lee, M (2008) Synthesis of and Statistics for Recent GPS-enhanced Travel Surveys, *Paper at the 8th International Conference on Survey Methods in Transport*, Annecy, France

Personal Communication Stephen Roddis 26/05/2011

Personal Communication Lindsay Oxlad 10/05/2011