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Summary:

Methodology of travel behaviour research

A discussion of methodological problems associated with national travel behaviour surveys

The objective of travel behaviour surveys is to explore the amount and pattern of travel of the population. In the surveys a sample of the population is questioned about their journeys, both everyday short trips and more occasional longer journeys, as well as the use of all modes of transport, walking included.

More specifically, travel behaviour surveys provide data on:

- The amount of travel
- The length of trips and the amount of time spent travelling
- How and why people travel
- To what extent different sections of the population undertake different kinds of journeys and how travel behaviour varies with place of residence.
- The geographical and temporal distribution of journeys.

Three national travel surveys (NTS) have been carried out in Norway. The first survey was carried out in 1984/85, the second in 1991/92 while the third was carried out in 1997/98. In addition, a number of local travel behaviour surveys have been carried out.

In connection with the submission of report no 32 (1995-96) to the Storting (the Norwegian Parliament) a motion was passed to "*carry out quadrennial travel behaviour surveys in connection with the revision of sectorial plans. Such surveys are important for the evaluation of changes and as a basis for action taken by the different sectors*".

NTS 1997/98 is the first in the series of quadrennial travel surveys.

The diversity of data from travel behaviour surveys makes them an important source of information for the transport sector. Data from the NTS is used for planning within the road transport and public transport sectors, as a basis for the development of transport models, for forecasts, for the calculation of exposure in road safety work and in a number of research projects. The data is also important as a basis for evaluating the results from studies of selected modes of transport or selected geographical areas.

This report summarises our experience with the NTS, undertakes a critical assessment of the methods employed and considers how they may be improved.

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Sample and method of sampling

The objective of the NTS is to obtain information on the travel behaviour of the Norwegian population. Interviewing the whole population is not feasible for practical and economic reasons. A representative sample of the population is interviewed instead. In practice, the sample in the NTS is restricted to people 13 years or older at the time of the interview living in a household with a non-mobile phone.

In order to be able to perform analyses on different subsections of the population with the results having a reasonable degree of precision, a sample of more than 6000 people were interviewed in the NTS 1997/98, allocated to the counties in proportion to their population

The NTS has been planned so that various kinds of additional samples can be drawn. In the latest NTS geographically restricted additional samples were drawn form Oslo/Akershus (the greater Oslo area) and Møre og Romsdal (a county on the west coast), 1752 and 995 people respectively. In principle, additional samples selected on other criteria can also be drawn, for example from different subsections of the population.

The passenger transport models utilise data from the NTS. The submodels for travel demand, possession of a driver's licence and car ownership in the National Passenger Transport Model have all been estimated (calibrated) on the basis of data from the NTS 1991/92. Re-estimation of the models on the basis of data from the NTS 1997/98 is desirable. For NTS data to be suitable for the transport models a data set of approximately 8,000 people representative of the whole country is necessary. In Sweden, where the travel survey is carried out continuously, data from several years are aggregated to obtain a sample of 40,000-50,000 people as a basis for modelling work.

In the NTS 1997/98 the database of Telenor (the main Norwegian phone company) has been used for the selection of respondents. From this database a random sample of phone numbers has been drawn, stratified on counties. This way, the first stage sample is a sample of households drawn from the phone number database. When the phone numbers are called, the person in the household being 13 years or older whose birthday was most recent is selected as the respondent, ie a random person is drawn for each household.

Different countries employ different databases to draw samples for their travel surveys. A survey of the sampling procedure in 13 western countries found that five countries drew their samples from registers of people, three from registers of phone numbers, three from lists of addresses and two from other surveys or population censuses. In Sweden and Finland, for example, people are sampled from the central register of people.

In the NTS one person from each household is interviewed. The same is done in the travel surveys in a number of countries, for example in the Swedish and Danish national travel surveys. In some countries where households are sampled, all or several of the persons of the household are interviewed. A drawback of interviewing only one person per household is that the possibility of considering the interviewee's journeys in connection with the journeys of the other members of the household is reduced.

The sampling method employed in the NTS ensures an unbiased sample of households. When persons are the units of analysis, the sampling method includes too few people from large households. Persons in large households have a smaller probability to be selected than persons from small households. To correct for the unequal sampling probability for persons from households of different sizes and so that analyses based on persons will be unbiased, the data from NTS 1997/98 have been weighted by the number of people 13 years or older in the household.

Methods of data collection

In the travel surveys data are collected by means of questionnaires with structured questions. The kind of information that is needed influences the choice of method used to interview the respondents. At the same time, the method chosen affects the questions that can be asked, as well as how they can be asked and which answers can be given. The costs of the different methods are also very different.

The most relevant methods for carrying out travel surveys are:

? interview by phone

? interview of people in their homes

? questionnaire filled in by the respondents

Table S.1 gives a summary of the areas in which the different methods of collecting data are most suited.

Table S.1: Use of different data collecting methods according to data type

Data collection method	Data type		
	Actual travel behaviour	Demographic data	Attitudes and appraisals
Interview by phone			
Individual	Yes	Yes	Limited
Household	No	Yes	Limited
Interviewing people in their homes	Yes	Yes	Yes
Questionnaire filled in by the respondents	Yes	Yes	Yes

In the NTS 1997/98 interviews by phone were employed. Interviews were carried out using the programme CATI (Computer Assisted Telephone Interviews). CATI entails an improvement and a simplification of phone interviewing compared with previous methods, since it facilitates instant control of the consistency of answers and at the same time avoids coding and punching errors.

In the first Norwegian NTS 1984/85 we called on people for interviews, ie the interviewer visited people in their homes and interviewed them there. Questions were read aloud to the respondent and the interviewer checked off the answer given in a questionnaire.

Data collection by questionnaires filled in by the respondent has not been employed in any NTS. The reason for this is the generally lower response rate for such surveys. It has been particularly difficult to achieve high response rates for postal

surveys, ie when questionnaires are both sent out to the respondents and returned from them by post. However, postal surveys have been employed in Norway for a number of local travel surveys.

Reporting of journeys

In the NTS a journey is defined as

"Any movement outside one's own home, school, workplace or holiday home - independent of the distance, duration and purpose of the movement and the modes of transport used".

The type of journey is delimited by its purpose. The purpose is usually determined by the activity at the destination. One or more modes of transport may be used on one journey. Walking and cycling are considered as modes of transport in the same way as car journeys and use of public transport. In figure S.1 there are six trips.

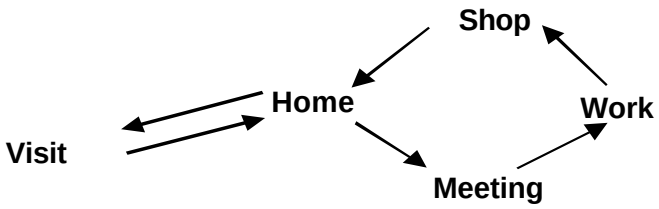

Figure S.1: The type of journey is delimited by its purpose

A number of studies have been undertaken to decide which methods are most suitable to ensure that people report all their journeys. There is relatively broad international consensus that reporting activities lead to better reporting of journeys than asking for reporting of journeys only. The reason is that travel is seldom the ultimate goal. We travel to be able to take part in activities. Journeys connect the activities. If we are to narrate what we have done, we remember the activities better, while the journeys are easy to forget. Experience, both from Norway and abroad, shows that short journeys, walking trips in particular, are the most underreported.

In the NTS the geographical location of the origin and destination of journeys is not recorded, except for recording the county of origin and destination for travel to work and other journeys of more than 100 kilometres. If we want to extend the use of the NTS as a source of data for the national passenger transport models, a more precise geographical pinpointing of the origin and destination of the journeys is necessary. In order to establish behavioural equations in these models it is necessary to know where, when and how people have travelled and to supplement this with information on the existing options.

Non-response and response rate

In the NTS 1997/98 the response rate in the main sample was 51 per cent. The response rate has declined considerably recent years. The non-response affects the quality of data. A high non-response rate reduces the precision of the estimates and

increases the risk of the sample being biased. It is therefore important and necessary to encourage people to take part. One possibility is to use reminders and warning in advance, i e by getting in touch with people previous to the interview, either in person, by phone or by letter, to let them know that they have been selected for the survey and to explain the purpose of the survey.

Non-response in travel surveys is not random. International experience indicates that non-response is highly correlated with;

- low income
- little education
- either no cars in the household or more than one car
- households either smaller or larger than the average
- unemployment
- living centrally in a town
- mobility either lower or higher than the average

We find that in the NTS 1997/98 people in their twenties and the elderly are particularly underrepresented. Non-response is higher among people who travel much and among people who travel little.

Interview duration and time of interviewing

The average duration of interviews in the NTS 1997/98 was 20 minutes. Experience from other countries shows that the duration of the interview affects both the quality of the data collected and the willingness to take part.

Travel surveys differ from other surveys in that the duration of the interview is dependent on the number of journeys undertaken, both the number of journeys the day before and the number of journeys longer than 100 kilometres during the last month. The more journeys, the longer the duration of the interview. It is not unreasonable to assume that respondents leave out some journeys, either because journeys are deliberately underreported, because they choose to believe that some kinds of journeys should not be reported, because they do not make any effort to remember their journeys or because of other distorting factors affecting their memory.

Underreporting can be difficult to avoid. It is therefore necessary to consider measures that may be initiated to reduce the underreporting of journeys. One measure is to reduce the duration of the interview. In the NTS this can for example be done by

- keeping interviews on everyday short trips and long journeys apart
- avoiding double counting of yesterday's work trips

Warning in advance notice may also contribute to a reduction of the duration of the interview in that the respondents will be able to prepare for the interview.

In the NTS the day before the interview is the period of interest. Respondents are required to report all journeys undertaken between 0 am until 12 p m on that day. However, peoples' travel behaviour varies within the week. These systematic variations from one day to another will not be captured when only one day's journeys are reported. In some other countries, for example in Britain, respondents are required to report all their journeys for several days.

Peoples' travel activity shows a definite seasonal variation, for the number of journeys as well as for the choice of transport mode and for travel purpose. In order to capture these and in order to obtain reliable data for the journeys of the population on an average day, data collection for the NTS takes place through a whole year. By interviewing every day, we believe that a reliable measure of the travel activity of the population on an average day is obtained.

Most travel surveys carried out are cross-sectional studies. Cross-sectional studies are only able to provide information on the state of the population at the time the study is carried out. However, by carrying out several cross-sectional studies information on the changes taking place may be obtained. In some countries travel surveys employing a panel has been carried out. Panel studies facilitate a more precise description of changes than cross-sectional studies. The drawback of panel studies is the risk of respondents dropping out between surveys so that the panel, ie people taking part in all the surveys, may be gradually reduced to a fairly small number.

Answers to questions and variables

There are a number of reasons for respondents not answering some questions in surveys or for the answers being of low quality:

1. Insufficient knowledge or not being able to remember
2. Do not understand the question
3. The question is too difficult to answer
4. The question is too personal
5. Deliberate misrepresentation and strategic answers.

Most questions and variables have a high response rate, but more than 19 per cent have not answered the question on their own annual income and more than 30 per cent have not answered the question on the annual total income of the household.

More than 30 per cent have not given information on how far the family car(s) has travelled the last 12 months. Furthermore, it seems to be difficult to estimate the distance travelled in kilometres and minutes. Both Norwegian and international research has shown that the difference between estimated and actual time spent can be considerable.

Methods exist to supplement data when the quality of data is insufficient or values on some variables are missing. The most commonly employed methods are:

1. The use of instrumental variables
   Substituting one variable with another that measures the same or a similar concept

2. Statistical imputation
   Imputation of data where the data matrix lacks values
3. Use of data from alternative sources
   Supplementing data and variables with data from external sources and registers.

These methods have not been used much in Norwegian travel behaviour research.

Comparability

An important goal for future NTS is comparability between periods. Comparison of different periods has several objectives:

- To contribute to a better understanding of the evolution of the transport sector
- To provide a basis for implementing various transport policy measures
- To make it possible to forecast the expected development
- To make it possible to increase the understanding of the general social development.

Despite the necessity of improvements and changes in the NTS over time, it is important to ensure that such changes are not introduced at the sacrifice of the comparability of the main areas. If changes are necessary, work should be done to develop methods to correct for them.

Changes have been made between the three NTS. The largest changes between the first and the two succeeding NTS are in:

? sampling methods

? data collection methods

? age limits

When comparing the NTS with other sources of data, as much information as possible on the circumstances of data collection is desirable. The more information there is on the various data sources, the more likely it is that this information can be taken into account when different kinds of data are used. The assumptions and presumptions for the various data sources are always somewhat different. Without this information, wrong conclusions may be drawn.

Further development of methodological skill

A continuous development of the methodology of travel surveys is necessary to enable the Institute of Transport Economics to provide the transport sector with data that are as reliable and as relevant as possible. Work relevant for this development is testing sample methods and data collection methods, improving the data matrix, designing of questionnaires and study design. In addition, it is important that resources are available to keep up with the international

development of travel survey methodology by attending conferences, reading international journals and publishing papers.