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Project Appraisal Guidelines for National Roads Unit 5.2 - Data Collection

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1. Introduction

This PAG Unit provides guidance on the data required to inform the development of transport models for the use in the appraisal of National Road projects. The Unit discusses available data sources, data collection techniques and also provides guidance on data quality and data processing procedures.

The outputs of any transport model are only as good as the data on which it is built. Transport models are used to inform the decision making process, therefore it is essential that the decision makers fully understand the quality of data used in the transport modelling process.

The quantity and quality of data collected should be proportionate to the scale and nature of the project. For major projects, data collection can be a costly exercise both in terms of time and money. Nonetheless, it should be noted that limiting both the quantity and quality of data collected can significantly reduce the reliability of the transport model and the decisions which it informs.

1.1 Project Appraisal Plan

The Project Appraisal Plan developed prior to the development of any transport model for a National Road project should set out the existing data/sources and data required to be collected to inform the development of the transport model. Full details of the requirements of the PAP are provided in PAG Unit 2.0: Project Appraisal Deliverables.

An appropriate amount of time should be allocated to data collection prior to the model building process to ensure that the quantity and quality of data is sufficient to allow a model to be constructed and, furthermore, that the data collected is relevant to the subsequent applications of the model.

1.2 Types of Transport Model

PAG Unit 5.1: Construction of Transport Models provides guidance on the various types of transport models and their applicability in relation to the appraisal of National Road projects. The type, quantity and quality of data required to develop these various forms of transport model varies significantly and depends on the nature and scale of the project and the decisions which the model will help inform. Table 5.2.1 provides an overview of the type of data required to inform the development of various model types outlines in PAG Unit 5.1: Construction of Transport Models.

Table 5.2.1: Transport Model Data.

Model Type	Network Inputs	Demand Inputs
Simple Models	Junction Geometry	Link Counts
	Aerial Mapping	Turning Counts
	Traffic Signal Data	Queue Lengths
		Pedestrian Data
Micro-Simulation	Junction/Link Geometry	Link Counts
	Aerial Mapping	Turning Counts
	Traffic Signal Data	Origin-Destination

Model Type	Network Inputs	Demand Inputs
	Public Transport Network	Journey Time
		Pedestrian Data
		Queue Lengths
Assignment & Variable Demand Models	Junction/Link Geometry	Link Counts
	Aerial Mapping	Turning Counts
	Traffic Signal Data	Origin-Destination (trip matrices)
	Public Transport Network/Services	Journey Time
	Zone Structure	Pedestrian Data
	Land Use Data (existing)	Queue Lengths
	Land Use Data (proposed)	Public Transport Passenger Data

2. Available Data Sources

There are several sources of existing data at a national, regional and local level that may provide the initial data required to develop a scheme specific transport model. These sources include but are not limited to:

- TII National Transport Model;
- NTA Regional Models;
- CSO POWSCAR database;
- TII Traffic Monitoring Units;
- Mapping Sources;
- Existing Transport Models;
- County Development/Local Area Plans; and
- Public Transport Statistics[1].

2.1 TII National Transport Model/ NTA Regional Models

There are two national transport modelling tools available for use by practitioners that can act as 'donor' models for more detailed Local Area Models (LAMs). The National Transport Model (NTpM) developed by TII and the framework of five Regional Models, developed by the National Transport Authority (NTA). Both of these modelling tools may be regarded as secondary sources of data and provide detailed information on zones, traffic flows, travel demand, mode share, journey times etc.

2.2 POWSCAR

The Place of Work, School or College Census of Anonymised Records (POWSCAR) database is produced by the Central Statistics Office (CSO) every five years following the national census. The POWSCAR dataset provides detailed data on the journey to work/education at Electoral Division (ED) level, including:

- Origin (residence) and destination (place of work/education);
- Time of departure; and
- Travel mode.

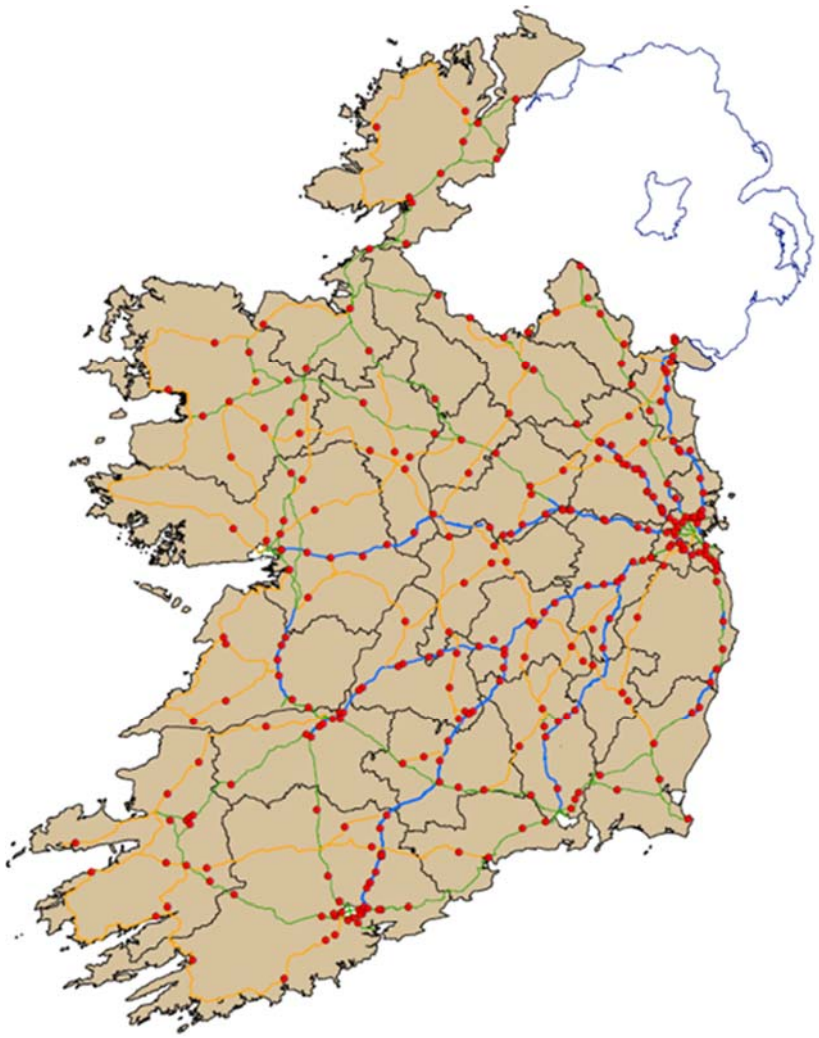
Aggregated outputs from the POWSCAR dataset informed the development of the journey to work and journey to education origin-destination (O-D) demand matrices used in TII NTpM and consequently in Local Area Models cordoned from the NTpM. Access to POWSCAR is restricted and must be applied for through the CSO.

[1] There are a range of published Public Transport Statistics available which should be referred to when developing a multi-modal model.

2.3 TII Traffic Monitoring Units

TII maintains a network of permanent automatic traffic counters known as Traffic Monitoring Units (TMUs). The TMUs are dispersed nationwide across the National Road network and include data for Motorway, National Primary and National Secondary routes. In addition, there are a number of TMUs located on Regional Roads generally where a bypass has been constructed and the former road has been reclassified. There are over 280 TMUs located on the road network. Figure 5.2.1 depicts a map of the network of traffic counters as of June 2016.

Figure 5.2.1: TII Permanent Traffic Counters (June 2016)



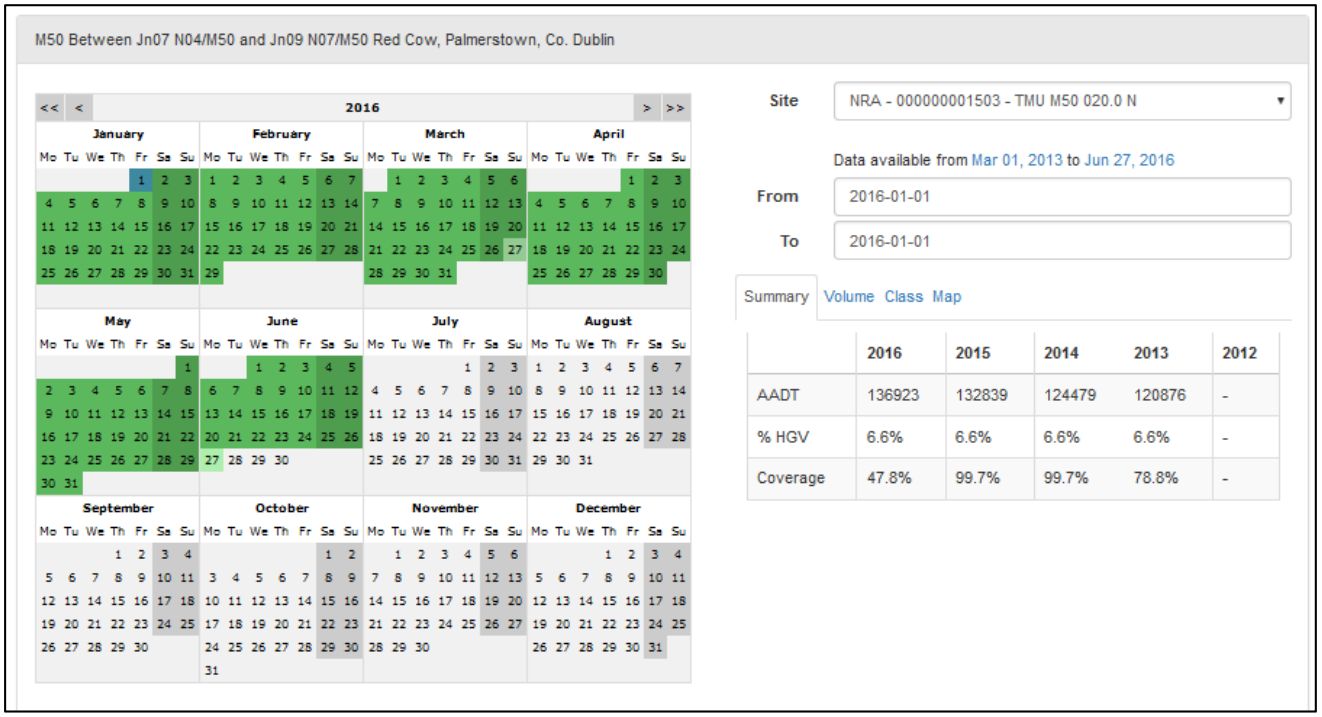
TMUs continuously record traffic flow data which is processed and uploaded to the TII Traffic Data website within minutes. The website uses a dynamic mapping interface to allow the user to access data in a variety of report formats.

The extensive network of TMUs provides a valuable source of data for roads throughout the country, they provide estimates of current and historical datasets such as those set out below':

- Annual Average Daily Traffic;
- Percentage Heavy Goods Vehicles (HGV); and
- Coverage of data collected. (% of yearly data collected).

In addition, the TII Traffic Data website includes downloadable Excel spreadsheets, with hourly directional traffic counts, daily directional traffic counts, weekly and monthly volumes. Traffic volumes can be filtered by direction, time period, and vehicle classification. In addition, there is also a facility to exclude data collected during holidays or events. A map is also provided to give a location of the TMU counter. Figure 5.2.2 depicts the TII Traffic Data Site interface for a typical TMU site.

Figure 5.2.2: TII Traffic Data Site Interface



TMU data may be used to provide calibration and validation counts in the development of transport models. In addition, TMU data can be used to develop peak hour expansion factors to calculate/represent AADT (as described in detail in PAG Unit 16.1: Expansion Factors for Short Period Traffic Counts). Other applications include using TMU data to produce a profile of traffic flows over the day.

2.4 Mapping Sources

Aerial mapping/photography can be used to inform the development of a transport network, provide information on existing land uses or provide clarity in the presentation of model outputs. Sources such as Ordnance Survey Ireland (OSI), Google Maps, Bing Maps or OpenStreetMap are also rich sources of this type of network information.

The Central Statistics Office (CSO) provides mapping of Electoral Divisions (EDs) and Small Area Population Statistic (SAPS) areas throughout the country. This information can be used to inform the zone structure used in assignment models.

2.5 Existing Transport Models

For a scheme under consideration an existing transport model may be available from a previous study. This model may be utilised in its current form if appropriate and justified, or provide the basis for the transport network and/or demand inputs for a new model.

It is important to note that the use of data from an existing model depends on several issues, including the age and quality of the data used to develop the model and the functionality of the original model. The use of an existing model should be outlined and justified in the Project Appraisal Plan and agreed with the TII Strategic and Transport Planning Section.

2.6 County Development and Local Area Plans

County Development Plans and the more detailed Local Area Plans are useful sources of data which can assist in the calculation of zonal trip ends for trip distribution as they provide information on existing land uses and zoned land.

2.7 Public Transport Statistics

There are numerous publically accessible reports and bulletins relating to public transport data and statistics that are published on a periodical basis by the CSO and the NTA, amongst others.

3. Data Collection Considerations

There are a number of considerations to be taken into account prior to, and during the data collection process, these include:

- Neutral Periods;
- Survey Specifications; and
- Data Checking/Cleaning.

3.1 Neutral Periods

In order to ensure an unbiased sample, all data collection should be carried out during a "neutral" or representative month, avoiding national and local holiday periods, local school holidays, mid-terms and any other abnormal traffic periods. Where a study area is impacted upon by a third level institution, surveys should also avoid exam periods (which can occur in late January and during May and June) as well as the longer holiday periods throughout the year.

Other periods to avoid include local festivals or unusual events, which may influence traffic at a local level; where an unusual event (including severe weather) occurs during traffic surveys it may be necessary to undertake the surveys again at a neutral time. For the purposes of data collection, with reference to guidance supplied in UK DfT WebTAG Unit M1.2 and the TII PAG Unit 16.1: Expansion Factors for Short Period Traffic Counts, neutral periods have been defined as Monday to Thursdays during the following periods:

- late March and April – excluding the period surrounding St. Patrick's Day and Easter;
- May – excluding the Thursday before and all of the week of the Bank Holiday;
- September – excluding school holidays and the return to school weeks;
- October – excluding the Thursday before and all of the week of the Bank Holiday; and
- All of November.

Bank Holidays (and the days before and after it) should be avoided. Neutral periods should be used unless alternatives are agreed in advance with TII.

3.2 Survey Specifications

Careful consideration must be given to the development of the survey specification in order to make sure that the appropriate quantity and quality of data is captured. Survey specifications will vary depending on the data to be collected but at a minimum the following should be specified:

- Details of Survey Type;
- Survey Dates and Times;
- Survey Location(s) including description, maps, coordinates and photos (as appropriate)
- Vehicle Categories;

- Units, both vehicles and PCU's[2] ; and
- Notes on any hindrances.

3.3 Data Checking/Cleaning

Good practice dictates that all traffic data should be sense/logic checked for any anomalies as part of standard data processing. For example, it is important to compare short term traffic volume counts to nearby TII TMU data to check for daily variations in the traffic flows. Data cleaning may be required for Road Side Interview surveys to reject any trips that may be deemed illogical.

In general all data should be checked to identify and remove any data that may have been affected by unusual events. When data quality is suspect, the data should be investigated thoroughly and, if necessary, rejected and replaced with relevant updated data.

[2] Vehicle to PCU conversation as per TfL Values; Motor Cycle – 0.4, Passenger Car/LGV – 1.0, Medium Goods Vehicle (MGV/OGV1) – 1.5, Buses and Coaches – 2.0 and Heavy Goods Vehicle (HGV/OGV2) – 2.3

4. Data Collection Techniques

The following sections of this PAG Unit provide an overview of the various forms of data collection that are available in relation to the collection of scheme specific transport data.

The methods chosen for data collection depend on the category of data being collected. Broadly speaking these categories are:

- Traffic Volume Data;
- Queue Length Surveys;
- Journey Time Data; and
- Origin-Destination (OD) Data.

For multi-modal models or for National Road projects which may directly impact upon pedestrian or cyclists, it is vital that data is collected to allow an understanding of the impact to public transport demand and/or vulnerable road users that a National Road scheme may have.

Techniques for collecting data for the above categories are provided in the following sections.

4.1 Traffic Volume Data - Link Counts

A link count survey which is commonly referred to as an Automatic Traffic Count (ATC) records each vehicle passing a fixed location by direction and according to a specified vehicle classification and speed. The classification of vehicles can vary but in general the classification should allow for the aggregation of vehicle data into the seven classifications recorded by the TII Traffic Monitoring Units:

1. Motorbikes;
2. Cars;
3. Light Goods Vehicles (LGV);
4. Bus;
5. Other Goods Vehicles 1 (OGV1);
6. Other Goods Vehicles 2 (OGV2); and
7. Caravans.

An ATC can be temporarily installed for a specified period or permanently installed as per the network of TII Traffic Monitoring Units which allow for the long term monitoring of traffic growth. Either type of ATC can provide useful supplementary information to a turning count or roadside interview data (which are usually undertaken on one day only) as they can indicate whether that survey day was typical or not.

ATCs may also be used to count the number of pedal cyclists but there are known problems with accuracy under this approach. For example, pneumatic tube counters deployed over multiple lanes of carriageway may not generate a big enough pulse to reach the counter. This problem is partly overcome by the use of a second (more sensitive) tube. Inductive loops are the most common method of counting traffic over a long period. However, the accurate detection of cycle flows under this approach is difficult.

It is normal practice for ATCs to be conducted for at least two full weeks. ATCs carried out for two weeks or longer will capture day to day variability. Furthermore, it is essential to place ATCs in favourable positions along links so as to avoid or minimise the likelihood of queues forming over the

counters as this leads to less accurate counts. In general, link counts should be undertaken on links that are liable to experience changes in traffic flow related to a scheme proposal.

At the most basic level, ATCs may be required for the development of simple junction models, microsimulation models as well as assignment and variable demand models. ATCs can be used to monitor traffic flows and to provide information about the relationship between survey day traffic and longer term flow levels. ATCs can also be used to provide information about local 12 hour, 16 hour, 18 hour and 24-hour flow ratios, and daily and seasonal traffic variations, all of which are required to estimate average daily traffic flows from shorter period data. In addition, good quality counts are required for both validation and calibration of link traffic flows in transport models.

4.2 Traffic Volume Data - Junction Turning Counts

A Junction Turning Count (JTC) survey provides classified turning movements at a junction and their complexity reflects the nature of the junction that is being surveyed. JTC's can be undertaken automatically using a video camera with post-production analysis to provide each turning movement e.g. Arm A to Arm B, etc. in a given time period (typically 15 minute intervals) and according to a specified vehicle classification. As outlined above, the classification specified should at a minimum allow for the aggregation of data into the seven TII TMU classifications and also allow for the classification of pedestrians and cyclists.

JTC surveys for national road projects should at a minimum record and classify data over a 12 hour period, generally between 07:00 – 19:00. However, alternative time periods can be discussed and agreed with TII in the Project Appraisal Plan. All results obtained should be classified into maximum periods of 15 minutes and should allow classification into Passenger Car Units as well as vehicles.

JTCs are required for simple junction models and micro-simulation models. Furthermore, JTCs are also required for the calibration and validation of junctions in assignment models. In the case of assignment models, JTCs should be carried out at all junctions within the model area that are likely to have a significant impact on journey times or delays and at junctions that are particularly significant in route choice.

More complex or large-scale junctions may require Automatic Number Plate Recognition (ANPR) surveys or Bluetooth/Wi-Fi device matching techniques in order to obtain an accurate result. In each case, observations are made on all arms into and out of a junction, expanded to total flows as necessary based on control total counts (link counts). Proprietary software can then match the number plate or MAC address of the Bluetooth/Wi-Fi device to provide a matrix of movements through the junction. With this type of approach it is often only possible to provide a maximum of two classifications, cars and goods vehicles, however ANPR can be manually analysed for additional classifications in exceptional cases where the benefits of the data outweigh the costs.

JTC surveys can include public transport vehicles which is important for validating public transport information input into models. For improved validation of the transport model, surveys can measure persons on board, through on-board manual counting, visual estimation or weight measurement devices on vehicles. Bluetooth/Wi-Fi device detection may also be used although in such cases a validated method for expanding the sample to a full count is necessary.

4.3 Queue Length Surveys

This type of survey is typically undertaken to calibrate a junction model or a micro-simulation model. They are also sometimes undertaken to provide an estimate of traffic conditions at a junction which is operating in excess of its capacity. In this instance, a standard JTC would effectively measure throughput or capacity (i.e. how much traffic can get through the give way line or stop line) rather

than demand. So the addition of the queued vehicles in each time period provides a more accurate picture.

Whilst these surveys are simple in principle, they can be difficult to undertake with any degree of consistency. Queue lengths are typically observed using a mounted camera which can give rise to issues of range and visibility. It can be very difficult to distinguish between slow moving and queuing traffic. It is also often the case that the queue will grow quickly as capacity is exceeded, in busy situations, and it can be hard to determine where the end of the queue is. This difficulty is of course compounded when queues tail back through upstream junctions and visibility is compromised by the camera range. Nevertheless, queue information must be collected to permit validation of junction models.

4.4 Journey Time Data

Much of the economic benefits of road improvement schemes typically come from time savings. It is therefore important that models accurately reflect the speed observed in reality. Knowledge of the prevailing journey time on links is also important when trying to calibrate model networks such that subsequent assignments reflect drivers' route choices accurately.

Comparison of observed and modelled journey times gives a measure of the appropriateness of the speed-flow relationships used in assignment models, as well as the junction delay calculations for a congested assignment model. Journey time surveys may also be used to identify junctions which exhibit high levels of delay and that need to be modelled in detail.

The routes chosen for the validation of journey times should cover as wide a range of routes as possible and cover the fully modelled area as evenly as possible. At a minimum routes chosen should include those on which it is expected that traffic will be affected by the proposed scheme, as well as covering the route including the proposed scheme itself, if appropriate.

For assignment models the validation routes should be neither excessively long (greater than 15km) nor excessively short (less than 3km). Routes should not take longer than the modelled time periods and start times should be staggered, particularly if runs are undertaken on the same day.

During the survey, total travel time should be recorded separately for each road section between major junctions and a separate note should be made of the delay time at each junction (since junctions are such an important component of the total travel time). Journey time runs, in both directions and in each model time period, should be made over a period of several days until a representative sample is formed. Variations in travel times during peak periods should be taken into account by staggering start times to represent fairly conditions over the time period as a whole.

As mentioned earlier, ATC surveys can provide speed measurements as can other techniques such as radar. However, these are 'spot' speeds and do not reflect the variation in journey time that may be experienced when traversing a network. This can be obtained using either Automatic Number Plate Recognition (ANPR), GPS tracking or Bluetooth/Wi-Fi device matching techniques as described earlier (each entry is time stamped) or by the moving observer method.

The moving observer method involves a survey team driving along a route at the prevailing speed of traffic. A number of timing points, usually significant junctions in the network, are chosen in advance and the time from the start to each point is recorded. However, unlike ANPR or other automated methods, the sample rate is likely to be low and therefore may not accurately represent the variation in journey time.

In some locations 'observed' journey time data may also be available using real time information available via Google Maps. The 'Live Traffic' tool in Google Maps provides real time information on all motorway routes in Ireland as well as some National Primary and Secondary roads.

4.5 Origin-Destination Data

Origin-Destination or O-D surveys involve obtaining detailed information about the movement of individual trips from one geographical location to another. Such surveys can take a number of forms including:

- ANPR/Bluetooth/Wi-Fi device matching/GPS tracking;
- Roadside Interview surveys (RSI);
- Public Transport surveys; and
- Household surveys.

ANPR surveys involve the collection of registration plate details of passing vehicles at a number of pre-determined locations at specific time periods. This allows an origin-destination matrix of movements by location to be created.

RSI surveys involve stopping drivers at the side of the road and questioning them about their trip hence. They provide the best sort of data for building demand matrices for models but can be costly and difficult to implement safely in certain situations e.g. high-speed roads. As the survey involves stopping vehicles at the roadside, the location and layout of the survey site is extremely important and An Garda Síochána permission and assistance will need to be sought.

Public Transport surveys provide information on trips undertaken by public transport and are used chiefly in the development of public transport multi modal models. They can be undertaken through interviews and/or counts on board vehicles and at stops/stations. They can also be arranged for self-completion by passengers.

Household surveys are similar to RSI surveys except the trip maker is asked to record their own trip information. The availability of Census journey to work information has largely eliminated the need for such surveys.

The purpose of the Origin-Destination surveys is to obtain a sample of the population in the study area who are travelling along relevant routes / corridors and obtain detailed information about the nature of their trip. This should include questions about:

- Trip origin;
- Trip destination;
- Trip purpose;
- Number of people in the vehicle; and
- Vehicle type.

Origin-Destination surveys undertaken must be conducted in such a manner as to allow aggregation of data to Electoral Divisions (ED) or sub-divisions of EDs for coding geographical zones. The sample rates for these surveys needs to be sufficient to accurately and reliably represent O-D movements.

Other procedures for collecting origin destination data may also be acceptable providing they can be shown to collect robust information using adequate sample sizes. These procedures should be discussed and agreed with the TII Strategic and Transport Planning Section prior to being undertaken.

4.6 Stated Preference Surveys

Stated Preference (SP) surveys provide information on the intentions of trip makers when presented with a number of choices to make. SP surveys use the choices made by trip makers under experimental conditions to estimate the value they ascribe to items (i.e., they state their preferences via their choices). SP surveys are normally undertaken in order to inform behavioural models such as willingness-to-pay, most relevant in the planning of tolling schemes.

Stated Preference data could be collated via: postcard surveys; home or phone interviews; and travel diaries.

4.7 Revealed Preference Surveys

Revealed Preference (RP) surveys refer to observations of actual behaviour, for example the mode choices that trip-makers currently make or made in the past. RP data are inherently more credible than SP data and their use, if only partially, will strengthen the credibility of demand forecasts in the appraisal framework. RP studies use the choices made already by trip-makers to estimate the value they ascribe to items (i.e., they reveal their preferences and hence values or utilities by their choices).

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