

## RURAL TRANSPORT SURVEY TECHNIQUES

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### Objectives of the paper

#### Abstract

Rural transport planning is placing less emphasis on infrastructure development, and more on the provision of transport services which meet the local community and individual needs. To understand the nature of these transport needs requires a much fuller appreciation (than has perhaps been the case in the past) of community life and the contribution that transport can and does make to sustainable livelihoods. It also requires a clear understanding of cross-sectoral linkages and the impacts throughout the local economy which result from transport development. This understanding can only be developed through local knowledge, with the joint participation of the enquirer, the local community and other stakeholders who have an interest in the outcome of proposals for transport development. Participatory enquiry also supports a much greater focus on poverty issues, and the role of transport in sustainable livelihoods.

Notwithstanding this need for participatory enquiry, there is still a need for the traditional surveys that establish the nature of the existing transport framework, and identify the opportunities for development. These surveys provide an inventory of transport infrastructure and services, as well as an appraisal of transport productivity. They can help to pinpoint measures (technical, institutional and financial) for improving efficiency. These surveys may also provide supporting evidence for community perceptions on transport, or exceptionally, may provide some contradictory arguments that would need to be resolved.

#### Key issues

- To highlight the use of participatory surveys for understanding travel needs in rural communities.
- To endorse the continuing need for surveys that catalogue the transport system, its development and its productivity.
- To highlight the complementary nature of different surveys, and the need to deploy resources over a range of survey types

#### Key topic areas

- Surveys which help to define and describe the transport system and opportunities for development
- 'Traditional' surveys used to establish the nature of transport demand, and for forecasting travel growth.
- Participatory surveys, and their role in developing local transport.

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## 1 INTRODUCTION

Rural transport surveys are typically undertaken in order to identify how well current transport functions, the opportunities for transport development and the needs of, or demand for transport that is expected over the foreseeable future. Variations on this general scheme include: monitoring the impacts (in its very widest interpretation) of transport and transport changes; monitoring how transport responds to both internal (e.g. regulatory change) and external (e.g. increased road charges) stimuli; and analysing changes to the organisational and institutional structures that support the transport sector. Surveys are required to provide both the quantitative and qualitative data upon which the appropriate analyses can be developed. There is a range of surveys available to the enquirer, and these can be grouped into two main categories that describe the basic purpose of the enquiry, which are:

- Supply surveys that describe the nature of the transport system, its scale and productivity, its bottlenecks and the scope for its development.
- Demand surveys that describe the way in which transport is currently used, or which describe current user satisfaction or how users would prefer to be supplied with transport to meet their needs.

These supply and demand-side surveys are applicable to all modes of transport, including freight and passenger carriage, as well as motorised, human and animal powered vehicles. The supply-side surveys are likely to be quantitative in nature, focussing on the establishment of performance indicators, growth factors, costs, etc. Many surveys yield data that is directly input into analytical models like HDM3 (Highway Design and Maintenance Standards) and HDM4 (Highway Development and Management). Comparative analyses using these data can be undertaken to good effect, both on a national and international basis. Given the right resources, these quantitative indicators are also relatively easy to monitor over time, and some database models have been designed for storage and analysis of this information (e.g. the Micro Accident Analysis Package, MAAP, and road maintenance management programs). Some qualitative information will be gathered to describe institutional structures, as well as the quality of transport provision (which may be a very important consideration for some transfers, e.g. perishable goods).

Demand-side surveys are also likely to be quantitative in nature, but there will also be a much greater degree of qualitative information gathering that describes user needs and satisfaction. Indicators (e.g. accessibility measures) may assist in quantifying some of these qualitative attributes, but they are not absolute measures. Demand attributes and aspirations are also likely to be much more tied to parochial factors, and hence less easy to analyse by comparative techniques.

## 2 SUPPLY SIDE SURVEYS

Table 1 outlines the main surveys that are applicable to the quantification of transport supply. The surveys cover both roads and transport services, though it will be evident that some surveys will provide information across this divide (e.g. it is possible to derive information on travel speeds from both in-vehicle surveys and passenger interviews). It will also be evident that some surveys provide information that is

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equally pertinent to a description of the demand-side: for example, the derivation from user interviews of user characteristics, attitudes and perceptions.

## **2.1 Road Surveys**

### **2.1.1 Inventories**

An inventory of the road network in the area of study may be needed to confirm the records of the highway agency. The records for an isolated area may be particularly vulnerable to error. Furthermore, an important component of the network, which will not be captured by the highways authority, are the paths and tracks that may provide vital communication links at the village level.

The detail required of the inventory should be established before its execution, and will cover the amount of measurement expected (road widths and lengths), identification of structures (bridges, culverts, etc) and other roadside furniture (road-signs). The inventory may be undertaken in association with the maintenance survey programme. Depending on the level of detail, the inventory can be accomplished visually from a vehicle, or may involve frequent stopping to complete measurements, or even 'walking the road'.

### **2.1.2 Traffic counts**

Traffic counts are conducted to record the level of use of a road, as well as to classify the vehicles by type, and to estimate vehicle occupancies (i.e. the average numbers of passengers carried by each vehicle type). Classification is particularly used to highlight the amount of heavy goods vehicles (HGVs), and is used in association with axle-load surveys to indicate both the design requirements and the amount of damage being inflicted on the road pavement.

Traffic counting can be undertaken manually, or more conveniently by automatic traffic counters. The latter can record and store information for long periods, before being read. Modern counters record information in electronic format that can be downloaded straight into customised traffic analysis software. (However, many of the automatic traffic counters currently available are not well suited to use in rural areas.) Automatic counters are also capable of recording vehicle classifications, although the accuracy is generally poor. Vehicle occupancy counts must be undertaken manually.

The main output from a traffic count is a measure of average traffic flow, recorded as the total traffic passing in both directions over a 24 hour period (the Average Daily Traffic or ADT). For low volume roads the variability in traffic flow from day to day can be very high, and short counting periods can introduce high errors in estimates. Variability from seasonality (with the possibility of impassability in the rainy season), may be important. Adjustment factors for seasonal variation are usually difficult to estimate with any degree of accuracy.

The accuracy of traffic counts is improved as the count duration increases, when the count is undertaken in more than one period of the year and on roads with higher traffic volumes. Improved accuracy can also be achieved by using local knowledge to determine whether there are days within the week or periods during the year when the flow of traffic is particularly high or low. Factors to look for include:

- market days

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- religious days
  - people travelling to and from urban areas for the weekend
  - wet weather affecting road traffickability and desire to travel
  - increased traffic flows during harvest seasons

It is also important to avoid counting on days when there is likely to be exceptionally high or low traffic, counting on these "exceptional days" can have a significant impact on accuracy. Factors to look for include:

- national holidays
- local holidays
- strike days
- closed borders

Traffic counts on low volume rural roads should also include pedestrians, bicycles and other non-motorised means of transport (NMT's). Local knowledge should also be used to pick appropriate locations for conducting the traffic counts to ensure a true reflection of the traffic using the road to avoid under or over counting. Factors to look for include:

- Avoid counting too close to towns and villages
- Be aware of the location of junctions and the impact of these on traffic flows
- Pedestrians and NMT's may use local footpaths and tracks in addition to the road. When counting this type of traffic ensure that the count station is located to capture all traffic
- Rural people predominantly travel as the sun is rising and as the sun is setting
- When counting in the wet season have knowledge of local diversions on poor roads

### **2.1.3 Travel Speed Surveys**

Measurements of travel speeds can be made directly through in-vehicle observation, or indirectly from the responses of shippers, transporters and passengers about the characteristics (including times) of their travel. The former (in-vehicle observations) will yield travel times that mostly reflect the performance of the road (i.e. the level of congestion and the passability of the road). The latter (user and transporter responses) may include other time components like passenger waiting times, times associated with goods loading/unloading, operational 'lost' times). Both measures may be important in different contexts of enquiry.

### **2.1.4 Road Maintenance Surveys**

These are periodic surveys of road condition, which may either be completed by visual inspection, or using instrumentation to measure key characteristics (surface roughness, rutting, etc.). In visual inspection a rating scale of road condition (perhaps covering several characteristics of the road) is used to assess the status of, or need for, maintenance. Increasingly, data from these surveys is stored in computer-based databases, which are used to analyse the information and help in the management of road maintenance programmes.

### **2.1.5 Axle-load Surveys**

These are undertaken principally to establish the nature of heavy goods traffic, and in particular the amount of vehicle over-loading. A significant amount of road damage is created by over-loaded heavy goods vehicles.

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### **2.1.6 Road Safety Surveys**

Police records of road accidents are the primary source of information on road safety. However, their records are subject to error and omission, and furthermore may be inadequate for the needs of the safety analyst intent on designing remedial measures. Some progress has been made in the design of improved data capture techniques linked to computerised databases (e.g. the TRL Micro Accident Analysis Package - MAAP), which are simple to use and helpful to the policemen in the field. By using graphic representation and simple 'tick-boxes', the Accident Report Form has been made much more user-friendly and, as a result, a more reliable source document which can pin-point both the location and the nature of an accident.

Road safety audits attempt to identify potential road hazards (and the need for remedial measures), based on the experiences of the auditor. Such surveys could be undertaken at the time of completing a road inventory, but require specialist knowledge.

## **2.2 Road User Surveys**

### **2.2.1 Operator Surveys**

Operators of both trucks and public transport can be interviewed to yield information that can be wide-ranging, covering: vehicle productivity and costs; labour utilisation and costs; tariffs and fare structures; route structures; operating practices; organisational structures within the industry. Operators are likely to be a useful source of information concerning constraints on the provision of services to rural and isolated areas. They are also likely to have candid views on regulatory policy, as well as providing an insight on vehicle design and maintenance.

### **2.2.2 Driver Surveys**

Drivers and operators may be one-and-the-same, but equally drivers may be employees of the vehicle owner or may hire the vehicle from the owner on a daily basis. Where they are not one-and-the-same, driver interviews may yield a different perspective on operating practices. Drivers can also be a source of information on vehicle productivity and costs comparable to that derived from the vehicle operators, particularly in the case where the driver is hiring the vehicle. This source is particularly useful in the informal or non-corporate sector, where vehicle owners may keep few records of vehicle utilisation.

### **2.2.3 Farmer Surveys**

Farmers are a main source of information on farm vehicles, which may also be used for carriage of goods and people on the highways. Vehicles may be animal powered or motorised. The types of information which farmers can yield are similar to those of operators and drivers. Farmers are also main users of haulage transport, and hence a source of information on transport services provision.

### **2.2.4 Passenger Surveys**

Passengers can be interviewed to obtain information about their travel and their satisfaction with service provision. They can also be monitored to capture information on their waiting times, the loading patterns on vehicles, average travel distances, etc. In-vehicle surveys use observers (the number depending on the size of vehicle) who monitor numbers boarding and alighting at each stopping point along the vehicle

journey. The same observers can also derive information on vehicle speeds by recording times of arrival at pre-determined timing points. By staying with one vehicle throughout the day, an observer can also determine information on the vehicles utilisation, productivity and revenue earnings.

### **2.2.5 Shipper Surveys**

Goods consignors (e.g. farmers) are a source of information concerning the quality of haulage, tariffs, the availability of choice, etc.

<b>Sector</b>	<b>Survey</b>	<b>Purpose/Potential Output</b>	<b>Indicator/ Comments</b>
Roads	<i>Inventory</i>	<i>To confirm Road Agency networks data. Inventory of local rural roads km. categorised by different road standards. Other details (road furniture, structures, etc.) may also be captured.</i>	<i>The Highways Authority records cannot always be relied on for accuracy. Paths and tracks are unlikely to be recorded at all.</i>
	<i>Traffic counts</i>	<i>To establish traffic levels hourly, daily and seasonal distributions and composition on the local road network. Hence to identify or confirm traffic congestion.</i>	<i>Measured as an estimate of Average Annual Daily Traffic (AADT). There can be extreme variation in daily counts on low-trafficked roads, as well as seasonal variation..</i>
	<i>Travel speed surveys</i>	<i>Average speeds and delays along local routes</i>	<i>Direct measurement of transport service on offer, as well as some indication of the road performance.</i>
	<i>Road maintenance</i>	<i>To establish the state of repair of the local network, and the need for remedial works.</i>	<i>Maintenance management systems are increasingly being used to keep track of the state of the road network. For local feeder roads this may be less practical, because of the isolation, difficulty in measurement and hence cost.</i>
	<i>Axle-load surveys</i>	<i>To establish the degree of vehicle over-loading, and hence the damaging impact on roads.</i>	<i>An important input into pavement design.</i>
	<i>Safety statistics and audits</i>	<i>To establish the location and nature of road safety hazards.</i>	<i>Accident rates and trends.</i>
Road users	<i>Operator surveys</i>	<i>To establish a variety of data: route structures; operating practices; fare structures or freight charges; vehicles in use and their characteristics; vehicle utilisation and costs; the nature of regulatory and institutional issues; prospects</i>	<i>Contributes to an assessment of passenger/freight service to the local community.</i>
	<i>Driver surveys</i>	<i>In many instances, similar information to that from the operator surveys.</i>	<i>The driver and operator may be one and the same in many cases. Where they are different, the driver may give a very different perspective to that of the operator.</i>
	<i>Passenger loading surveys</i>	<i>To determine the productivity of a passenger vehicle, but this survey can also be used to measure vehicle speeds and average passenger journey distance.</i>	<i>Indicators of vehicle productivity, and possible identification of scope for improving output.</i>
	<i>Passenger waiting time surveys</i>	<i>To measure the level of service (frequency of service and waiting times).</i>	<i>A performance indicator of the transport service on offer.</i>
	<i>Passenger interviews</i>	<i>To measure journey distances and times, fares paid, satisfaction, preferences.</i>	<i>Contributes to measurement of the performance of transport service, as perceived by user.</i>
	<i>Shipper interviews</i>	<i>To measure journey distances and times for consignments, tariffs, satisfaction, preferences.</i>	<i>Contributes to measurement of the performance of transport service, as perceived by the user.</i>

**Table 1: Supply-side Surveys**

### **3 DEMAND-SIDE SURVEYS**

The survey techniques used in rural transport projects have become more participatory in their methodology, and now tend to focus on the household and community level. This is because the increasing focus on poverty analysis has highlighted a failure to involve the poor in the development and refinement of public policy, and in the enrichment of their own lives. Participatory enquiries contribute to the development of sustainable livelihoods analysis, which seek to establish how individuals, households and communities can enhance their prospects through better access to basic needs and opportunities. Hence, participatory methods have been adopted in association with more conventional qualitative methods.

The latter, more traditional methods of enquiry include origin-destination surveys, cordon surveys, household surveys and stated preference surveys. The outputs from these are largely quantitative, and may sometimes be directly input into transport planning models (though this is more a feature of urban transport planning).

Table 2 indicates the main survey types, which are described in a little more depth below. The participatory instruments are presented last, with some more detail about their background.

#### **3.1 'Traditional' Travel Demand Surveys**

##### **3.1.1 Origin-destination Surveys**

Origin-destination surveys seek to establish the nature of travel patterns in and around the area of enquiry. Typically, on the basis of sampling, an estimate is made of all daily trips between and within a pre-defined set of zones. The zones are usually based on existing demographic and political divisions, for which some socio-economic data may be available. The trip information is usually presented in matrix form, or graphically with a line (with width proportional to size of trip-making) linking each pair of zones and representing movements between any pair of zones. This information can be further refined by presenting, say, public transport trips separately from private vehicle trips.

##### **3.1.2 Cordon and Screen-line Surveys**

These surveys yield similar information to an origin-destination survey, though on a smaller scale since they only capture traffic movements across the screen or cordon. As indicated above, they are often used to up-date an earlier origin-destination survey.

##### **3.1.3 Stated Preference and Revealed Preference Surveys**

In Stated Preference Surveys respondents are given the opportunity to make choices between proposed transport options. Questions are structured in such a way that the analyst can have some confidence that the respondent is making a logical selection. The technique, which has its origins in market research, can be used to gauge the likely support and demand for a particular option. The analyst can also establish how the respondent 'trades' between different attributes of transport options, and in particular between time and money. Hence, through this technique it is possible to derive a value of time.

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Revealed Preference Surveys seek to establish in retrospect how respondents reacted to changes in transport that have been completed, and to use this information as a model for future change.

### **3.1.4 Household Surveys**

These surveys are used to establish the nature of travel, and the attributes (mainly socio-economic) of the household that influence their travel. For example, income and vehicle ownership may be strongly associated with more frequent or longer trips. In this way Household Surveys are used to develop demand-forecasting models based on these types of association.

Panel Surveys involve the same set of households and individuals being interviewed over time, a means by which the long-term effects of change can be monitored (see, for example, Airey and Cundill, 1998).

## **3.2 Participatory Surveys**

### **3.2.1 Village Leadership Discussion**

This provides a means for obtaining base data about the community, and an overview of its travel patterns, transport constraints and problems. Such a gathering, with a structured discussion, is seen by Barwell (1988) as the first stage in developing a dialogue with villagers about their transport problems and improvements.

### **3.2.2 Participatory Poverty Assessments**

Participatory Poverty Assessments (PPAs) emerged in 1993 when they began to be implemented in association with the World Bank Poverty Assessments supported by DFID and SIDA (Swedish International Development Authority) as a means of seeking a deeper understanding of the causes and consequences of poverty; they seek solutions in policy and practice which will break the cycle of persistent poverty and lead to its sustained reduction. PPAs seek to understand poverty from the viewpoint of the poor themselves, and include their voice in decision-making processes that affect them. Poverty is not simply an economic condition, it involves other intangible issues such as vulnerability, social exclusion, powerlessness and insecurity which traditional methods of poverty analysis are unable to capture because they fail to understand how the rural poor perceive their own status. PPAs enable transport practitioners to learn about the poor, the assets available to them, and their capacity for recovery.

### **3.2.3 Rapid and Participatory Rural Appraisal**

Participatory Rural Appraisal (PRA) and Rapid Rural Appraisal (RRA) came into being in the late 1970s, in response to the criticism of the assumptions upon which earlier development work was based. PRA and RRA emphasise a transfer of knowledge between researcher and participant, a relationship that has replaced the one way transfer of knowledge from the north to the south. PRA involves the thorough analysis of rural peoples' situation by the rural people, and allows them to identify solutions to improve their situation, whereas RRA facilitates the transfer of knowledge from locals to outsiders in a cost-effective way. Refer to Paper 5:6:a on Participatory Rural Appraisal for further information.

<i>Survey types</i>	<i>Surveys</i>	<i>Purpose</i>	<i>Indicators/Comments</i>
<i>'Traditional' Transport Surveys</i>	<i>Origin-destination surveys</i>	<i>To identify current travel patterns of a population. Travel movements and variations are identified between pre-defined origins and destinations.</i>	<i>Often carried out at the household level, in association with a household survey. They should capture all trips, but non-motorised trips have often been ignored.</i>
	<i>Cordon and screen-line surveys</i>	<i>Similar to and origin-destination survey but carried out on a smaller scale across an imaginary screen line or cordon around the area of enquiry.</i>	<i>These surveys only capture trips crossing the screen or cordon. They may also ignore non-motorised and even public transport trips.</i>
	<i>Stated Preference and Revealed Preference Surveys</i>	<i>To try to establish (in advance) how respondents might respond to proposed transport changes/or to monitor how respondents did respond to a transport change (and hence to use that as an indicator for future potential changes).</i>	<i>Both techniques are well formalised, and proprietary software is available for analysis of responses. A by-product of the analysis is an estimate of time-values.</i>
	<i>Household Surveys</i>	<i>To establish travel patterns and their relationship with household characteristics, as a means for modelling future transport demand.</i>	<i>Household surveys can be extremely expensive.</i>
<i>Participatory Surveys</i>	<i>Village Leadership Discussion</i>	<i>In all participatory surveys, the aim is to understand the context and the problems as perceived by local people, (i.e. the stakeholders) and also to get them involved in developing solutions</i>	<i>Developing sustainable livelihoods, and understanding cross-sectoral links, requires a participatory approach.</i>
	<i>Participatory Poverty Assessments</i>		
	<i>Rapid Rural Appraisal</i>		
	<i>Participatory Rural Appraisal</i>		

**Table 2: Demand-side Surveys**

**KEY REFERENCES**

Barwell I (1988). Guidelines for remote area transport and socio-economic surveys. Report for the Transport, Communications and Tourism Division, UNESCAP. Ardington: IT Transport.

Booth D et. al. (1998). Participation and combined methods in African poverty assessment: renewing the agenda. Social Development Division, African Division, Department for International Development. London: DFID.

Brocklesby M A and Holland J (1998). Participatory poverty assessments and public services: Key messages from the poor. Swansea: Centre for Development Studies, University of Wales.

Holland J (1997). The use of qualitative survey material to inform the design of the Core Welfare Indicators Questionnaire: a report for the social development and poverty elimination division of the UNDP. Swansea: Centre for Development Studies, University of Wales.

Mikkelsen B (1995). Methods for development work and research: a guide for practitioners. New Delhi: Sage Publications.

Norton A and Stephens T (1995). Participation in poverty assessments. The World Bank, Environmental Papers 020. Washington, D.C: World Bank

Robb C M (1997). Is local knowledge legitimate? Influencing policy through participatory poverty assessment. World Bank: Draft.