

## 1991-92 Commercial Vehicle Survey: A Presentation and Discussion of the Survey Methodology

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### Abstract:

The Transport Study Group of NSW is conducting a survey of commercial vehicles with a registration address in the Sydney, Newcastle, Central Coast, Wollongong and Blue Mountains region. The objectives of this survey are to obtain up to date statistics on the movement of commercial vehicles and goods within the survey area.

After detailing the areas of inquiry that the present survey addresses, this paper describes the sampling design adopted, which aims at achieving a self weighting probability sample of commercial vehicles over a 12 month period.

This paper also presents a detailed description of the recruitment-call mailed-out mailed-back survey procedures and an analysis of the survey response obtained during the first six months.

Based on this experience, the applicability of alternative data collection procedures and survey methodologies to surveys of this type is discussed.

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## **Background**

The Transport Study Group of NSW (TSG) is a State Government organisation. It is sponsored by the Department of Transport, Roads and Traffic Authority, State Rail Authority, State Transit Authority and Department of Planning. It is funded by these organisations and by State Treasury.

Its objectives are to help the development of both long and short range road and public transport planning options to serve the present and projected transport demand in Sydney and other areas of NSW.

A Home Interview Survey (HIS) is in progress for the 1991-92 period. This survey is the third in a series and provides a comprehensive data set of personal travel behaviour sampled on a household basis. The HIS instrument does collect vehicle characteristics such as model, age, engine capacity, etc; however it does not obtain detailed information in regard to commercial vehicle travel. Specifically, data on goods carried is not collected.

In view of the economic value to the State of the goods transported (Balce, Yeomans 1992), information about the travel pattern of commercial vehicles is important in planning for total transport needs.

Accordingly, a decision was taken to conduct a Commercial Vehicle Survey (CVS), to run in parallel with the HIS and to complement it. A broadly based survey of commercial vehicles in urban areas has not been undertaken before in Australia. The entire survey could therefore be considered a pilot survey. This view is reinforced by the lack of published material on previous commercial vehicle surveys.

The present paper is focused on detailing the sampling and survey design adopted. A range of opportunities and difficulties presented during the first six months of the survey are discussed.

## **Survey Overview**

The survey area can be described as the Sydney Statistical Division, comprising the Sydney, Newcastle, Central Coast, Wollongong and Blue Mountains region.

A pilot survey of 270 vehicles was carried out during September 1991. Results from this survey suggested some changes to question wording and significant procedural changes. For the main survey, 30,000 vehicles were chosen. The duration of the main survey was 12 months, commencing on 28 November 1991.

The survey content was designed by TSG as discussed below. Sample design was carried out by TSG in consultation with the Australian Bureau of Statistics (ABS). Field procedures design, final questionnaire design and layout, fieldwork and data coding were carried out by AGB Australia in consultation with TSG. AGB Australia was requested to sign a strict confidentiality agreement, and to

implement specific data transferral and database access procedures to guarantee the confidentiality of the data being managed.

### **Survey Objectives**

The CVS had four main objectives:

- provision of a reliable platform for learning how the urban freight system operates
- provision of information about current usage of the urban road network for freight transport and other commercial purposes
- provision of an overview of vehicle operations to assist in targeting tightly future data collection and analyses
- provision of a broadly based dataset with sufficient key fields to permit subsequent, more focused, survey data to be integrated successfully

### **Survey Content Design**

As noted in Balce and Yeomans 1992, before embarking on the survey, TSG considered: data requirements, collection methods, modelling techniques and what focus might be appropriate, viz

- Statewide vs urban coverage
- industry/activity, commodity or vehicle based
- freight carrying vs "all" commercial vehicles.

In the formulation of the survey content, detailed consultations were carried out at working party level. Over a period of twelve months various options for both the survey instrument and its contents were explored in consultation with:

- NSW Roads and Traffic Authority
- NSW Department of Transport
- Long Distance Road Transport Association
- Transport Workers Union
- NSW Road Transport Association

The final survey design provided for a vehicle-based survey of "all" commercial vehicles focussed in the major conurbation of Sydney, Newcastle, Central Coast and Wollongong and the Blue Mountains. Specific categories such as taxis and buses were excluded from the survey since more efficient methodologies exist for accessing data about these groups. Commercial vehicles were included in the survey population if their registered address fell within the survey area.

### **Survey Data Items**

For each selected vehicle operating over a 24 hour period on one specific day, the following data items were collected by means of the CVS:

#### **a) for the vehicle**

- the travel date and day
- the type of vehicle employed, categorised into:
  - goods van
  - utility
  - pick-up
  - 4WD
  - 2 axle rigid
  - 3 axle rigid
  - 4 axle rigid
  - 2 axle prime mover
  - 3 axle prime mover
  - other
- general use of the vehicle (whether to carry freight, tools of trade or other functions such as commercial or business related transactions or services or transporting passengers)
- type of fuel used
- other vehicle characteristics such as make, model and body type
- trailer type (if applicable)
- the load on the vehicle at the beginning of the survey day

#### **b) for each trip:**

- the origin and destination
- the origin start time and destination arrival time
- the travel time between the origin and destination calculated from start and arrival times
- the reported distance travelled
- up to three main roads taken per origin-destination pair
- the weight of each delivery and pick-up
- the three main commodity types delivered and picked-up at each stop. These were categorised according to the ABS Australian Transport Freight Commodity Classification (ATFCCO) coding
- for articulated vehicles, the configuration at the beginning of the survey day and configuration changes (if any) at each stop

**Sampling Design**

The sample frame was the computerised listing of RTA motor registration records for the target population. This database has its limitations as discussed below.

The following fields (either contained on the frame or derivable from it) were used for sample selection process:

- plate ID
- geographical region of registration (see Table 2)
- whether the vehicle was part of a large fleet (defined as those which contain more than 100 vehicles)
- light, rigid or articulated vehicle
- RTA vehicle body code (detailed classification)

The sample design was chosen to achieve a self-weighting probability sample of non-privately registered vehicles, with a registration address in the study area for each of three vehicle types: light, rigid and articulated. This vehicle classification is in line with the ABS Survey of Motor Vehicle Use (SMVU) classification and was approached by grouping RTA vehicle registration codes.

Vehicles in large fleets and other vehicles formed separate strata and the sample was controlled to ensure an even spread over days of the week and quarters of the year in each stratum. In addition, the design provided for simple calculation of sampling errors for a variety of estimates from the survey.

A separate sample was drawn each quarter to enable the most recent version of the sample frame to be used. Later versions of the frame were matched with lists of vehicles selected in previous quarters to prevent duplication.

Resource considerations dictated that around 7,500 questionnaires could be processed. With an expected response rate of around one in four (CVS pilot survey, Sept. 1991), a selected sample size of 30,000 for the year or 7,500 each quarter was chosen.

Taking into account the likely variation in travel characteristics within each vehicle type, the approximate sample sizes chosen are shown on Table 1.

For vehicles in large fleets, the sample was stratified by vehicle type, giving three strata. Other vehicles were stratified by three vehicle types and 13 geographical regions, a total of 42 strata. The regions were loosely based on ABS Statistical Subdivisions, with amalgamation to account for the low numbers of registered vehicles in some subdivisions as outlined below in Table 2

**TABLE 1 - DESIGN SAMPLE SIZE**

Vehicle type	Population (Oct 1991)	% of total sample	Approximate sample size (qtr)	Sampling fraction (qtr)
Light	221,598	27.7	2,077	0.9814%
Rigid	94,975	56.7	4,253	4.4780%
Articulated	7,909	15.6	1,170	14.7933%
<b>Total</b>	<b>324,482</b>	<b>100.0</b>	<b>7,500</b>	<b>2.3114%</b>

TABLE 2 - GEOGRAPHIC REGIONS

<u>Region</u>	<u>ABS Statistical Subdivision</u>
1	Newcastle
2	Gosford - Wyong
3	Outer Western Sydney Blacktown - Baulkham Hills
4	Hornsby - Ku-ring-gai Manly - Warringah Lower Northern Sydney
5	Central Western Sydney
6	Fairfield - Liverpool
7	Canterbury - Bankstown
8	Inner Western Sydney
9	Inner Sydney Eastern Suburbs
10	St George - Sutherland
11	Outer South Western Sydney
12	Illawarra balance (Wingecarribee SLA)
13	Wollongong

#### Sample Selection Procedure

Each quarter, the registration data base was queried to provide the required fields for all vehicles in the defined population. These data were imported into two SAS datasets, one for vehicles in large fleets and one for other vehicles. These two datasets contained only vehicles not selected in previous quarters.

The steps outlined below were followed each quarter for each of the 42 strata. All procedures were programmed into SAS.

#### Selection of stratum sample size

Multiply the total number of vehicles in the stratum (including those sampled in previous quarters) by the sampling fraction (see Table 1) for the appropriate vehicle type.

#### Selection of sample within stratum

Vehicles not in large fleets were sorted within strata by body code, with random order within each body type. Vehicles in large fleets were grouped by fleet. The lists were each sorted into random order at the lowest level (body type or fleet). Within each stratum, two half-samples or "replicates" were selected systematically with two random starts and a skip interval to give half the desired sample. The first

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vehicles selected in each replicate formed the first pair for calculating sampling errors, the second vehicles the second pair, and so on.

In the second, third and fourth quarters, vehicles selected in previous quarters were deleted from the frame prior to selection.

#### Allocation of Travel days

Fleet and non-fleet selections were amalgamated for the purposes of allocating travel days. The week was broken into six "days" so as to achieve half as many selections on weekends as on weekdays. An independent random ordering of days of the week was applied to each selected stratum. The method ensured that the selected pairs were allocated as evenly as possible to travel days both within strata and across groups of strata adjacent to each other; a serpentine ordering was used to facilitate later amalgamation of regions.

#### Field Procedures

In designing field procedures, emphasis was placed on reducing respondent burden by minimising the interview time for any one member of the target organisation. A two stage survey procedure was designed which separated the collection of vehicle information from trip information. The timing of procedures is summarised in Table 3 and described in more detail in the following sections.

Each quarter, TSG provided the fieldwork contractor with a computer file of the vehicles sampled for that quarter. Each record of this vehicle file contained the plate ID, registered name and address, vehicle type, travel date, and a flag indicating whether the vehicle was part of a large fleet. The Electronic White Pages system was used to obtain telephone numbers of sampled vehicle owners.

**TABLE 3 - FIELDWORK TIMETABLE**

Event	Date relative to Travel Date (TD) (days)	
	Start	End
TSG contact letter	-15	
Recruitment call	-8	-5
Questionnaire mailed out	-8	-4
Pre-travel reminder call	-1	0
Survey day	0	0
Post-travel reminder call	+1	+3
Mail-back reminder call	+5	+7
Cut-off date	+20	

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A random sample of 10% of vehicle owners unlisted in the Electronic White Pages system was drawn and interviewers were sent to each of the corresponding registration addresses. On arrival, interviewers were instructed to complete a field report specifying whether the sampled vehicle owner was located at the registered address and, if applicable, obtain a contact telephone number at that location.

Vehicle owners for whom a telephone number was obtained, were sent a contact letter two weeks before their travel day. This letter explained the need for the information being collected and asked their cooperation with the 1991-92 CVS.

Large fleet owners were recruited by telephoning their Fleet Manager or Operations Manager. Upon agreement to participate in the survey, this representative was provided with a list of fleet vehicles selected for the quarter and asked to return it to AGB after completing the following details:

- depot or garage address
- a contact name and telephone number at that address

### The CATI System

Initial direct contact with the respondent was by telephone. A Computer Assisted Telephone Interview (CATI) procedure was used to locate the appropriate contact person, either the Fleet Manager or the driver. There were four types of phone calls attempted as described below. Each step of the CATI process had call-back procedures built in to maximise response.

*Recruitment Call:* The purpose of this call was to identify, locate and recruit the most appropriate contact to participate in the survey. It was the most important call of the survey because the cooperation of the respondent was elicited at this call. The relevant contact person should have received the TSG contact letter explaining the purpose of the survey.

Once recruited the usual garaging or depot address of the vehicle was used by CATI to filter and terminate those vehicles which were out-of-area. Eligible respondents were asked 7 to 10 questions about the vehicle itself. Subsequently, the person who would be driving the vehicle on the survey day was identified and an address obtained for mailing the trip questionnaire obtained.

*Pre-Travel Day Reminder Call:* This call was made the day before the survey day. Apart from alerting the vehicle driver of the proximity of the survey day, it reminded the respondent of two important points:

- the definition of a trip (stop).
- that the questionnaire must stay with the vehicle on the travel day. (This means that if the vehicle is driven by two or more people on that day, the questionnaire needs to be handed over to the new driver).

*Post-Travel Day Reminder Call:* The purpose of this call was to remind the driver to mail back the questionnaire and, in cases where the questionnaire was not

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completed during the survey day, to urge the respondent to do so before the details of that travel day are forgotten.

*Mail-Back Reminder Call:* This call was made if the questionnaire had not been received 5 days after the survey day. Its purpose was to find out if the questionnaire had been mailed and to remind the respondent of the importance of the information being collected.

Trip Information

Trip information was gathered from the vehicle driver by a self-completed mail-back questionnaire. Three separate questionnaires were designed to eliminate questions not relevant to the particular vehicle type, thus simplifying completion.

Tracking System

Management of all field operations was achieved through a computerised tracking system. The system allowed immediate feedback on status of contact attempts, refusals, tracing of partially completed interviews, re-contacts, location of questionnaire from time of posting through receipt, editing and coding. This system was linked to CATI and updated at the end of each day.

TABLE 4 - TRIP QUESTIONS

Question	Light Vehicle	Rigid Vehicle	Vehicle with Trailer
What was the configuration of this vehicle at the start of your first trip?			X
Were you carrying any goods when you started your first trip?	X	X	X
What was the weight of all goods on the vehicle?		X	X
Where did you start your first trip today?	X	X	X
What time did you start this trip?	X	X	X
Where did you go on this trip?	X	X	X
What time did you arrive at this address?	X	X	X
Please estimate the distance travelled on this trip?	X	X	X
Name up to three main roads you used on this trip?	X	X	X
Did you deliver any goods to this address?	X	X	X
What was the weight of all goods delivered?		X	X
Did you pick up any goods at this address?	X	X	X
What was the weight of all goods picked up?		X	X
Did you add or remove or change trailers at the end of this trip?			X
What is the new configuration of this vehicle?			X

**Response Rate Report**

Due to the complexity of the procedures implemented to manage the fieldwork component of the CVS, it is difficult to report response rates with precision for any period of time other than the full survey period (12 months). The figures reported in Table 5 are therefore only indicative. These figures were obtained from the tracking system at the time this paper was due for submission (May 1992), which is roughly six months after the commencement of the survey.

It can be seen on Table 5 that sample loss due to the inability of establishing a telephone number for the registered owner is about 11%. Of all CATI attempts, 46% of them resulted in a successful recruitment, 34% were ineligible, 10% refused to participate and 10% could not be contacted at all.

**TABLE 5 - RESPONSE RATE SUMMARY (25TH MAY 1992)**

Sent to CATI	12,758	85%
Ready for CATI	592	4%
Phone No not found	1,650	11%
<b>Number of selections</b>	<b>15,000</b>	<b>100%</b>
Recruited	5,802	46%
Ineligible	4,317	34%
No contact	1,313	10%
Refusal	1,267	10%
Awaiting recruitment	59	0%
<b>Sent to CATI</b>	<b>12,758</b>	<b>100%</b>
Questionnaires received	4,305	74%
Drop out after recruitment	849	15%
Still being phoned	648	11%
<b>Recruited</b>	<b>5,802</b>	<b>100%</b>
Usable questionnaires	4,247	99%
Unusable questionnaires	58	1%
<b>Questionnaires received</b>	<b>4,305</b>	<b>100%</b>

**BREAKDOWN OF INELIGIBLE RESPONSES**

Not a commercial vehicle	1,415	33%
Vehicle sold	910	21%
No trace of person/vehicle	776	18%
Other ineligible	496	12%
Vehicle off the Road	312	7%
Out of Survey area	236	5%
Not suitable	172	4%
<b>Ineligible</b>	<b>4,317</b>	<b>100%</b>

At the time at which the figures that form Table 5 were obtained, 74% of those successfully recruited had returned a questionnaire (99% of these were 'usable', ie not blank), 15% refused after being successfully recruited and 11% were still in the CATI process.

As a preliminary comment it can be said that of the samples sent to CATI (12,758), 4,305 or one in three have returned a questionnaire up to the date at which these figures were extracted. A point worth mentioning is that the major sample loss so far is due to vehicles classified as 'ineligible'. The main component of this category are vehicles registered or classified as commercial by the RTA's registration's database, but claimed by the owner to be used for private purposes only. This phenomenon will be taken into account across the 42 strata when the survey results are expanded.

Another two factors contributing to the 'ineligible' status are 'vehicle sold' and 'no trace of vehicle/owner'. These last two factors reflect, to some extent, the aging of the database since samples were drawn about a month before the beginning of each quarter.

## Discussion

The choice of sample frame provided a unique opportunity for sampling but created some known difficulties. It was known from the outset that the survey would not encompass travel by the following significant classes of vehicles:

- interstate registered long-haul vehicles
- all vehicles registered out of survey area which may enter the area during the course of business
- vehicles registered to a company with a business address out of area but with sub-depots in the area (eg Coles with a head office address in Melbourne).
- vehicles registered as private that occasionally make commercial trips

It is acknowledged that these gaps in the sample frame will lead to an "incomplete" and biased database. The survey will not produce a complete origin-destination matrix of commercial travel in the study area. These problems were known to TSG from the outset, but supplementary surveys will be planned to cover these deficiencies.

The respondent recruitment technique judged to be most cost effective was telephone contact. However, the lack of owner's telephone numbers in the registration's database implied that an extra process needed to be implemented. To this end, a computer program was written to access the Electronic White Pages (EWP) in batch mode. Although this system worked quite satisfactorily, some of the sampled vehicle owners were untraceable. For instance, field visits showed that some owners are listed under the company name in the registrations database, and under their personal name in the EWP.

A problem related to telephone recruitment (or any type of recruitment) is locating the right person to talk to upon contact. With owner drivers this is usually

a simple task. With larger organisations, transferrals and call backs are usually needed. In some cases, the interviewer needs to recruit the fleet manager, the depot manager and sometimes the driver. In other cases, the interviewer does not get to talk to the driver of the vehicle and has to rely on somebody else to get the questionnaire and any verbal remarks to the driver. This creates a situation in which not all respondents are approached in an standardised manner.

The CATI and Tracking System implemented by the fieldwork contractor were a critical resource in managing a project of this magnitude. The set-up cost was quickly offset by the ease with which information about the status of any questionnaire could be retrieved, flagged and modified.

The choice of measuring instrument was dictated by the study objectives and available resources. Contacts with fleet managers, transport operators and owner drivers showed that the trip information sought would be best obtained from the vehicle driver on the survey day. A face to face interview with the driver was assessed to be beyond budget resources. The chosen technique (mail-out mail-back driver completed questionnaire) allows a much larger sample and a better coverage of the study area than a face to face approach. However, using a self completed questionnaire, some control over data quality issues such as completeness of answers, correct interpretation of questions and on the spot validity checks was lost.

The pilot study demonstrated that in order to achieve results with this self completion technique, trip information needs to be kept to a minimum and the number of trips limited to no more than 20. Discussion with transport industry representatives indicated that most drivers will make less than 20 trips a day, but it was also pointed out that some drivers (ie couriers) can make up to 60 trips a day. To capture some of this information drivers were asked to report the numbers of extra trips (if any) and the time at which the last trip was completed at the end of the questionnaire.

A preliminary analysis of the response obtained to date indicates that there are a number of coding issues to be addressed. For instance, TSG has automated the geocoding of origin-destination addresses. Although this geocoding software utilises a fair degree of 'artificial intelligence', some addresses are reported in a way in which manual coding or preliminary editing is necessary (ie destination for trip 5 reported as 'same as trip 3')

Commodity coding also presents its problems. Although a standard code frame is being used, the vast number of commodities moved within the network and the many names used by different drivers for the same commodity, make reliable commodity coding a formidable task. In view of this, TSG decided to code to the second level of ATFCCO rather than the more precise fourth level.

Finally, consideration was given to the time coverage of the survey. Due to reported seasonal fluctuations on the movements of goods and services, it was decided to use a longitudinal approach where information was collected over an uninterrupted period of a year. This created some problems in terms of getting continuous cooperation from fleet owners, since, given the equal probability sample design of this survey, large fleets had a number of vehicles selected each quarter.

These problems have impacted on survey response rates and underline the need for different survey instruments and/or procedures to be tailored to specific target groups. Moreover, as these instruments complement each other in an attempt to obtain a complete picture of the freight movement system, key fields and

coding conventions are needed to allow the successful integration of the collected information.

### **Conclusions**

Based on the experience gathered through the various stages of this survey, the following conclusions are drawn:

- The 1991-1992 Commercial Vehicle Survey is likely to fulfil its promise of filling a gap in the commercial vehicles movement knowledge base by:
  - providing detailed information about current usage of the urban road network for freight transport and other commercial purposes
  - contributing substantially to the efficient design of future surveys of commercial vehicles
- No single data collection methodology is likely to yield a full set of data that can be used study all aspects of the Transport Industry
- The design of future surveys should include key fields to allow information from more specific surveys to be merged to form a broad dataset.

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**References**

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