GENERAL NOTE

The Transport Planning and Design Manual (the TPDM) consists of eleven volumes and is published primarily as a working document for Transport Department staff. It also provides information and guidance to others involved in the planning and design of transport infrastructures in Hong Kong.

It is intended that the information contained herein will be periodically revised to take account of the most up-to-date knowledge and experience. The inevitable time-lag however, means that certain sections may at a particular time be unavoidably not up-to-date. For this and other reasons, the standards contained in this manual should not be followed rigidly but rather treated as a framework within which professional judgment should be exercised to reach an optimum solution.

Generally speaking, the standards contained in the TPDM generally apply to new traffic and transport facilities and should not be considered as exhaustive. Situation may arise for which considerations and requirements are not fully covered by the TPDM. Practitioners are particularly required to exercise professional judgement when dealing with existing facilities that are subject to site constraints, and to endeavour to take into account the views from stakeholders. Practitioners are also advised to make reference to other publications relevant to their designs such as the latest legislations, code of practices, guidelines, datasets, etc. before applying the TPDM.

Transport Planning & Design Manual

VOLUME 8- Surveys

TPDM Volume 8 Chapter 1 – General

1.1 References

(i) Survey Method in Social Investigation -C.A. Moser & G. Kalton, Heinemann 1979

(ii) Survey Sampling -Leslie Kish, John Wiley & Sons 1965

(iii) Sampling Technique -W.G. Cochran, John Wiley & Sons 1977

(iv) What Is A Survey -Hong Kong Statistical Society 1984

(v) Manual on Traffic Surveys -United Nations 1971

(vi) Urban Origin-destination Surveys U.S. Department of Transportation 1973

(vii) Traffic Appraisal Manual -U.K. Department of Transport 1982

(viii) Survey Methods for Transport Planning – Richardson, Ampt and Meyburg 1995

(ix) Introduction to Survey Sampling – Graham Kalton 1983

1.2 Traffic and Transport Surveys

1.2.1 The Needs for Surveys

1.2.1.1 The development of traffic and transport solutions to tackle encountered or anticipated problems is a very sophisticated process. It involves the establishment of comprehensive procedures and working arrangements by which short and long term transport plans are conceived, developed, evaluated and continuously monitored. The process generally requires a very good data base to render its smooth implementation. The data is mainly used in developing various transport models used as tools in various transport planning process.

1.2.1.2 Data required for a transport study varies according to the objectives of that study. Generally speaking, data commonly required is related to economic indicators of the whole territory, socio-economic characteristics of the population, land use pattern, the provision of transport facilities including that for public transport, travel pattern including origin-destination distribution traffic condition including traffic count and journey time, as well as transport inventory such as parking space and their characteristics.

1.2.1.3 Any observation or investigation of the facts about a situation may be called a survey. But today the work is most often used to describe a method of gathering data or information from a number of individuals, a "sample", in order to learn something about the larger population from which the sample has been drawn.

1.2.1.4 Before a decision is made for the conduct of a survey, consideration should be given to check whether the required data or information can be obtained from other existing data sources. A number of government departments, particularly the Census & Statistics Department, carry out regular surveys, from which the required data may be obtained. In some cases, the required data may also be extracted from existing government administrative records.

1.2.2 Regular Surveys Conducted By Transport Department

1.2.2.1 To provide the requisite traffic and transport data as the basis for decision making, the following types of surveys are conducted either on a regular or ad hoc basis: -

(i) Annual Traffic Census (Chapter 2)

(ii) Car Journey Time Survey (Chapter 3)

(iii) Spot Speed Survey (Chapter 3)

(iv) Parking Space Inventory and Parking Level Survey (Chapter 4)

(v) Parking Characteristic Survey (Chapter 4)

(vi) Franchised Bus Survey (Chapter 5)

(vii) Public Light Bus Survey (Chapter 5)

(viii) Taxi Survey (Chapter 5)

(ix) Franchised Ferry Survey (Chapter 5)

(x) Queuing and Delay Surveys (Chapter 7)

(xi) Pedestrian Survey (Chapter 7)

(xii) Origin and Destination Survey (Chapter 7)

(xiii) Home Interview Survey (Chapter 6)

1.3 General Survey Design Principles

1.3.1 Survey Objectives

1.3.1.1 Before planning to conduct a new survey, it is necessary to ascertain just how much is already known on the subject in question. This step based on common sense is often overlooked by planners, with the result that many surveys either obtain data which simply duplicate that which is already available, or obtain data which is not completely appropriate to the problem at hand.

1.3.1.2 Once the need to conduct a survey has been established, the first step in planning a survey is to lay out the objectives of the survey explicitly. The objectives should be as specific, clear-cut and unambiguous as possible. However, one should distinguish between the survey objectives and the general objectives of a research project to which the survey is serving. While the objectives of a research project are basically oriented to problem-solving, the objectives of a survey are more operational in nature, e.g. the objectives of a taxi review exercise may be set to identify whether there is an adequate level of taxi service, while the objective of a taxi survey conducted to support the review exercise may just be to estimate the average vacant taxi headway in the Territory as an indicator of the overall level of taxi service.

1.3.1.3 One of the obvious objectives of a survey is to collect the information or data required. Therefore, the most important initial task is to define clearly the data to be collected. If it has not been done in the early stage of the survey, there is the risk that the survey may fail to produce the desired results. In doing so, one may need to state clearly the reasons for carrying out a survey, exactly what questions it means to cover, and what kind of results is expected. More importantly, the objectives may include a statement on how the information is to be used and what degree of accuracy is required.

1.3.1.4 Once the objectives are set, the plan of the survey is then directed to achieving them with the required accuracy and within the given resources. Any widening of the scope of the survey, whether requiring more data to be collected or an extension to other population groups, should then be carefully assessed to ensure that the resources will not be spread too thinly for the survey to achieve its main objectives.

1.3.2 Survey Coverage

1.3.2.1 A population consists of a number of units of enquiry or investigation called elements. In the actual planning of a survey, the first step is to define the population to be studied. For example, where this is a requirement of the survey, the geographical areas, modes of transport, the roads and the households to be covered should be defined explicitly.

1.3.2.2 It is useful to distinguish between the population for which the results are required (i.e. the target population) and the population actually covered (i.e. the survey population). Ideally the two should be the same, but for practical reasons there will usually be some differences between them. The relatively less important elements of the target population may be deliberately excluded from the survey coverage due to their large amount in number and thus the substantial additional cost required to include them all in the survey coverage. For example, in a home interview survey to estimate the future travel demand for the whole Territory (i.e. target population), areas like the outlying islands and some remote areas in the New Territories will usually be excluded in the survey coverage (i.e. the survey population) as travel in these areas by mechanical mode is extremely light or non-existent and therefore not a representative of future demand resulting from development. Target population elements also may sometimes be excluded due to technical reasons.

1.3.3 Method of Data Collection

1.3.3.1 The choice of method for collecting the data is governed by the subject matter, the unit of enquiry or investigation and the scale of the survey. The method of obtaining data can be classified in many ways. For the purpose of surveys for transport planning/ studies, the following grouping is convenient:-

(a) Self-administered questionnaire

(b) Interviewing

(c) Direct observation or measurement

(d) Automatic measurement

While the above grouping is a useful classification for surveys for transport planning/studies, the methods can also be combined. Indeed a combination of methods is often more appropriate to make use of their different strengths. Not only can more than one method be used in any survey but also some problems can be, usefully investigated through separate surveys involving different approaches. It should be noted that each method has its own limitations, and in many instances a combination of methods has much to commend. The decision as to which method or combination of methods should be used for a survey does depend on a large number of factors such as resources constraint, timing, staff availability and required level of precision, etc.

1.3.3.2 The following paragraphs of this section describe briefly the various methods of data collection commonly employed in traffic and transport surveys including their advantages and disadvantages. More detailed discussions on their practical applications are presented appropriately in Chapters 2 to 15.

1.3.3.3 Roadside Observation

(i) In a roadside observation survey; the unit of investigation may be the pedestrians or the vehicles. In considering roadside observation as a method of enquiry, its value must be assessed in relation to that of the alternative methods of collecting information, such as asking people for the former case or measuring the required information by automatic measuring machine for the latter case.

(ii) Direct roadside observation on pedestrians can have a number of advantages over asking for information from informants. This is obvious if the only information required is simply the counting of number of pedestrians and their simple characteristics, which can be directly observed, say sex and age group.

(iii) If the unit of investigation is the vehicle, direct questioning of the drivers of the vehicles will be an extremely difficult task, if not at all impossible. If the required information is simply the counting of the vehicles and the recording of information of the vehicles which can be easily observed, for example, the type of vehicle, the use of automatic measuring machine may be another alternative for data collection. However, the large amount of investment required for the latter alternative may render it impractical and thus leaving the direct observation to be the only alternative.

(iv) Roadside observation is the most frequently used method by transport planners in gathering transport planning data because of its simplicity in collecting and timeliness in producing the required data.

(v) Though observation as a method has some important merits, there are also limitations. One obvious risk is the high probability of observational error due to human fatigue. In practice, a number of observers may be needed to record the required information in turn. Even so, it should be noted that such observational error may still not be totally eliminated.

(vi) Roadside observation surveys are widely used in collecting road system performance measures such as traffic flow, vehicle classification and occupancy. However it should be recognised that the system performance measures obtained on any one day are but single points from the distributions of the system performance measures. For example, travel time will vary from day to day for any given trip. In designing surveys of system performance, allowance must be made for the variability inherent in each of the parameters under observation.

1.3.3.4 Roadside Interview

(i) In this technique, a sample of the pedestrians or vehicles is stopped at the roadside and an interviewer obtains the required information by questioning the pedestrians or the drivers of the vehicles.

(ii) The success of the roadside interview method depends to a great extent on the voluntary co-operation of the pedestrians and the vehicle drivers. Roadside interview is however inevitable when detailed information is required from the informant which cannot be obtained by direct observation. One obvious example is a survey to obtain information relating to the origin and destination of travel for the pedestrians or the vehicle drivers. However, the number of questions to be asked should be minimized so that the pedestrians or drivers are not unnecessarily delayed. The contents and structure of the interview form are therefore very important.

(iii) It should be noted that like the method of direct observation, the roadside interview method is also subject to a number of disadvantages:

(a) This technique will cause delay to the pedestrians and vehicle drivers, and may result in a high refusal rate. Simply ignoring this refusal cases may lead to a bias to the overall estimate. Care must therefore be taken to keep this to the minimum.

(b) For roadside interview of vehicle drivers on high volume facilities, there may be some traffic delay to other vehicles during the survey, especially during peak travel periods.

(c) The technique of roadside interview of vehicle drivers is often dangerous, especially on high volume facilities, because survey personnel must operate on the highway and interfere with the regular flow of traffic. To ensure the security of the survey personnel, proper signing for the roadside interview should be used. It will also be highly desirable if the Police are approached for assistance in setting up the survey, e.g. location of survey, identity of interviewers, control of traffic.

1.3.3.5 Automatic Traffic Counting

i) This is a more accurate method than direct observation in measuring traffic flow. The function of this technique is to detect the number of vehicles transferring detectors laid on/in the road. Although this method overcomes some of the limitations of the direct observation method, it requires substantial investment in instruments, ancillary equipment, transport, data handling system and staff time.

1.3.3.6 Moving Observer Method

i) Information on flows, speeds, running and journey times can be obtained conveniently by observers travelling in moving cars. The moving cars will be driven to and fro along the route under investigation. Observers inside the car will then record down the number of vehicles passing in the opposite direction, the number of vehicles overtaking the test car and also the number of vehicles which the test car itself overtakes. Based on these information, the average flow, average journey time, average journey speed and average running time for a route can then be calculated.

1.3.3.7 On Board Survey

i) This method is usually used for measuring the usage of public transport. For the case of buses, the content of a bus between stops may be obtained by observers travelling in selected buses and recording the initial number of occupants and the numbers boarding and alighting at each stop.

ii) On board surveys are widely applied in collecting information or opinion of particular group of public transport users. In particular, when these users only represent a small percentage of the total population and they are difficult to be found by means of a general household survey, on board survey will be an effective survey method.

1.3.3.8 Mail Questionnaire Survey

i) Without doubt, the mail questionnaire method is generally cheaper than other methods. It simply involves sending out of the self-administered questionnaires to the respondents for filling in and sending them back.

ii) It is appropriate for questions demanding a considered rather than an immediate answer. In particular, if the answers requires, or would be more accurate as a result of, consultation of documents, a questionnaire to be filled in by the respondent in his own time is preferable.

iii) Mail questionnaire surveys are generally much less expensive than a comparable personal interview survey. It is estimated that the cost of a telephone interview survey was approximately three to four times more expensive per completed response than a hand delivered and collected self-completion survey. A personal interview survey is even more expensive than a telephone interview survey. However, self-completion surveys almost always have lower response rates than personal interview surveys, and hence the cost per returned questionnaire is much higher than the cost per distributed questionnaire.

(a) The method can be considered only when the questions are sufficiently simple and straightforward to be understood with the help of printed instructions and definitions.

(b) Mail questionnaire is inappropriate when spontaneous answers are required.

(c) Answers to all the questions may not be treated as independent.

(d) It may not be sure that the right person completes the questionnaire.

(e) There is no opportunity to supplement the respondents answers by observational data.

v) Some of the disadvantages of mail questionnaire can be overcome by combining it with interviewing. Thus questionnaires can be sent by mail and collected by interviewers who can clear up difficulties, check answers and ensure completeness. Conversely, questionnaires can be delivered in person and returned by mail, the visit being used to explain the purpose and methods of the survey and to elicit co-operation.

vi) More details on the design principles for questionnaires can be found in Section 6.5, Chapter 6 of Volume 8 of TP&D Manual.

1.3.3.9 Home Interview Survey

i) A home interview is a conversation between the interviewer and the respondent with the purpose of eliciting certain information from the respondent, taking place in the household within which the respondent resides.

ii) Home interview technique has a lot of advantages in terms of accuracy and amount of information that can be collected. A longer interview time can be designed for each visit to a respondent, relative to other techniques, thereby allowing the interviewer to explain more details of the survey questions to the respondent on the one hand and to obtain more information on specific areas of interest to transport planning on the other hand.

iii) In general, higher response rates may be obtained from personal interview surveys than from self-completion surveys. Response rate of the order of 75% to 85% are not uncommon.

iv) However, this type of survey calls for substantial resources in terms of time, money and manpower.

1.3.3.10 Telephone Interview Survey

i) When compared with the home interview method, the telephone interview method is much more cheaper. However, its operation depends on the availability of a comprehensive list of telephone numbers for the population covered by the survey.

ii) The reliability of the information collected by and the response rate for the telephone interview method may be very low. It is therefore mainly restricted to surveys of simple nature involving the asking of a few simple questions, such as a simple opinion survey.

iii) Despite the shortcomings of the method at its own, the method however is usually used to supplement other survey methods such as the mail questionnaire survey or the home interview survey. For example, any non-contacted household members in a successfully contacted household may be followed up by telephone interview method instead of paying another visit to the same household thereby saving manpower and time.

1.3.4 Sampling

1.3.4.1 Traditionally, the word Census is used to denote a complete enumeration as distinct from the word survey which denote a partial enumeration associated with a sample. The term sample survey is therefore usually used if part of the population being studied is selected by accepted statistical methods. For most of the time, the population being studied is so large and dispersed that complete enumeration is usually ruled out by shortage of money, time or trained manpower. Put it in another word, sampling can therefore save money, labour and time for carrying out an investigation. Added to these practical advantages, a sample survey often permit a higher overall level of accuracy than a full enumeration. The small numbers allow the quality of field staff to be at a higher level; more checks and tests for accuracy can be afforded at all stages; more care can be given to editing and the analysis. Finally, fewer cases make it possible to collect and deal with more elaborate information from each enumerated population element. When the estimates of the population characteristics are made from the sample results, the precision of these estimates can also be gauged from the sample results themselves.

1.3.4.2 Sampling Frame

i) One of the decisive factors in sample design is the nature of the sampling frame available, e.g. item lists, indexes, maps or other population records from which the sample can be selected at each sampling stage. A frame is basically a listing of all the population elements to be investigated.

ii) A frame is perfect if every population element appears in the frame separately, once, only once and nothing else appears on the list. Perfect frames may not always be available and we may sometimes need to use frames with deficiencies that should be detected and remedied as far as possible. Some common frame deficiencies include missing population elements, clusters of elements, blanks or foreign elements, and duplicate elements.

iii) Therefore, the first thing a sample survey designer needs is to know what frames are available and how far they enable one to sample the designed population completely, accurately and conveniently. If no suitable frame exists, one may have to be constructed.

iv) There are some populations for which no frame can be found, and among these might be pedestrians passing along a footway, vehicles passing along a road link and passengers of a particular public transport mode. In such cases, other sample selection techniques like quota sampling may have to be used.

1.3.4.3 Sample Design

i) Sample design consists of two aspects: a selection process for a sample of some members of the population by certain rules and operations; and an estimation process (or estimator) for computing the sample statistics which are sample estimates of the population values. The sample design is often determined by the survey objectives. However, the determination may sometimes be a two-way process because problems of sample design often influence and change the survey objective.

ii) Two major principles underline all sample design. The first is the desire to avoid bias in the selection procedure, the second is to achieve the maximum precision for a given outlay of resources.

iii) Bias in selection can arise from the following reasons:-

(a) If the sampling is done by a non-random method, which generally means that the selection is consciously or unconsciously influenced by human choice;

(b) If the sampling frame which serves as the basis for selection does not cover the population adequately, completely or accurately;

(c) If some selections of the population are impossible to be enumerated or refuse to co-operate

All of these factors will cause systematic, non-compensating errors which cannot be eliminated or reduced by an increase in sample size.

iv) Bias arising from unsatisfactory frames or from non-response (either due to refusal or other technical problems) has nothing to do with the selection process and thus their control has to be treated separately.

v) The distinguishing features of a properly designed sample are that all the elements in the target population have a known, non-zero chance of being included in the sample, and the sample design is described in sufficient detail to permit reasonably accurate calculation of sampling errors. In the selection process, randomness lies at the base of all the sample designs. These features make it scientifically valid to draw inferences from the sample results about the entire population which the sample represents.

vi) The sample size to be chosen for a survey should be based on how reliable the final estimates must be. In practice, usually a trade-off is made between the ideal sample size and the expected cost of the survey.

1.3.4.4 Simple Random Sampling (SRS)

- Simple random sampling is the fundamental technique of sampling. Other kinds of sampling are variations on this method. The basis of the SRS method is a random selection process which gives each of the population element to be covered a calculable and non-zero probability of being selected. Random selection is also referred to as probability sampling. An unrestricted random sampling method is one with unit selected at each draw being replaced into the population before the next draw is made. If unrestricted random sampling is modified to sampling without replacement so that no unit can appear more than once in the sample, the procedure is then called simple random sampling (SRS). With SRS, each possible sample of n different units has an equal chance of being selected, which also implies that every member of the population has an equal chance of selection into the sample. SRS is preferred to unrestricted random sampling because it produces more precise estimates. Computational formulae with illustrative example for the mean and variance for SRS are given in Appendix I.

1.3.4.5 Systematic Sampling

- Simple random sample can be drawn by making use of a random number table. However, for operational convenience, the process of random selection is usually approximated by a process of systematic sampling. To take a systematic sample is to take every kth element from a list of population units when k is the sampling interval equal to the inverse of the sampling fraction. The technique of systematic sampling satisfies the requirements of a truly random sample as long as there is no bias in the ordering of the sampling list. In actual operation, a random number between 1 and k, say RN, will be selected first. Then the sample to be selected will consist the units RN, RN + k, RN + 2k, , RN + (n -l)k. Its great advantage is that it saves time and cost over simple random sampling. The estimation and variance formula for the mean and ratio for a systematic sample will be the same as those of SRS.

1.3.4.6 Stratification

- It is clear from the formula of variance for SRS given above that one way of increasing the precision of a simple random sample is to increase its size. However, this is not the only way and another method called stratification is used in virtually all sample designs. Stratification means that before any selection takes place, the population is divided into a number of strata which can be regarded as groups of the population units which are more or less homogeneous in the characteristics under investigation. Then a random sample, usually by SRS, is selected within each stratum. If the sampling fraction is the same for every stratum, this procedure is almost certain to be an improvement on a SRS method because it makes sure that the different strata in the population are correctly represented in a population. Thus stratified random sampling with a uniform sampling fraction tends to have somewhat greater precision than SRS. Stratified sampling does not require that the sampling fraction is the same within each stratum. If there is such a uniform sampling fraction, the design is known as a proportionate stratified sample. If there are variable sampling fractions, the sample is a disproportionate stratified sample. If SRS method is used within each stratum, the procedure is called proportionate or disproportionate stratified element sampling. Computational formulae with illustrative example for the mean and variance of a stratified element sample are given in Appendix II.

1.3.4.7 Cluster and Multi-stage Sampling

- A population can generally be regarded as being made up of a hierarchy of sampling units of different sizes and types. In SRS, the sampling units are the elements of the population so that each sampling unit contains a single element. Cluster sampling denotes methods of selection in which the sampling unit contains more than one population element. Hence, the sampling unit is a cluster of elements. In each selection, a whole cluster of elements is being selected, and then within each of the selected cluster, one can either include all the individual elements which it comprises or only a sample of them. The process of sampling complete groups of units is called cluster sampling while situations where there is any sub-sampling within the clusters chosen at the first stage are covered by the term multi-stage sampling. However, in actual usage, the two terms may also be interchangeable. Basically, it is the desire to lower the field costs that leads to the use of a cluster sampling design especially when the population elements are quite scattered geographically. Another reason for clustering arises when no satisfactory sampling frame for the whole population exists, so that a listing of some kind has to be made specially. In view of the probable homogeneous characteristics of the population elements within a cluster, the precision of a cluster sampling scheme is often less than that of a SRS scheme for the same sampling size. However, cluster sampling can be much more economical than simple random sampling both in drawing the sample and in conducting the survey. For example, interviewers' travel cost and time can be reduced substantially by the use of cluster sampling. Computational formulae with illustrative example for the mean and variance for cluster sampling are given in Appendix III.

1.3.4.8 Replicated Sampling

- The case of standard error calculations is a factor to be taken into account in designing a sample. One design which yields simple formulae for standard errors is the replicated sampling. With this design, a number of sub-samples rather than one full sample are selected from the population. All the sub-samples have exactly the same design and each is a self-contained and adequate sample of the population. Replicated sampling can be used with any basic design: with stratified or non-stratified, single or multi-stage samples. With replicated sampling, sample estimates can be calculated for each of the sub-samples and the variation between these estimates provides a means of assessing the precision of the overall estimate. Whatever the complexity of the sample design, all the sampling errors are reflected in the variation between the sub-sample estimates. Computational formulae with illustrative example for the mean and variance for replicated sampling are given in Appendix IV.

1.3.4.9 Quota Sampling

- This type of design has a selection procedure in that once the general breakdown of the sample is decided, the actual selection of the sample is left to the field workers. Quota sampling is therefore a method of stratified sampling in which the selection within strata is non-random. It is this non-random element that constitutes its greatest weakness but it has the advantages of being cheap and administratively convenient.

1.3.4.10 Sample Size

Once we have decided on the sample design to be adopted and before the actual sample selection is conducted, the sample size has to be determined. In general, the sample size is determined with due regard to available resources and precision level required. Detailed computational formulae for the determination of sample size is given in Appendix V.

1.3.5 Administration and Control of Survey Operation

1.3.5.1 Organization of Field Work

i) Field operation is a vital part for a successful survey. Typically, a survey team consists of three types of personnel, namely office staff, interviewers (or field workers) and field supervisors. The office staff is in charge of the whole operation and controls the numerous forms that flow in both directions. The interviewers (or field workers) obtain the data directly. The field supervisors, the liaison between the office staff and the interviewers, carry a great deal of the responsibility for seeing that the whole operation works smoothly.

ii) The quality of the data to be collected is of obvious importance in a survey. Training of interviewers or field workers therefore needs specific treatment. Before the commencement of the field operation, a briefing session should be arranged for all the staff involved in the field operation. This not only ensures that they understand the survey procedures, the method of data collection, the operation of any equipment involved and the questionnaires to be used, but also that these matters are interpreted in a similar way by everyone involved.There are Six broad areas of training should be included into the briefing session:

(a) Survey objectives and design – the underlying reason for carrying out the survey, the objectives set out by the investigator and the reason for selecting the methodology which has been chosen.

(b) Questionnaire details – interviewers should be familiarised with the details of each question on the questionnaire to be used.

(c) Interview techniques – definition of terms presented in the questionnaire should be clarified, and coding conventions for field-coded questions, the degree of probing and clarification allowed for each question should be specified.

(d) Sampling frame – interviewers should know how the sample was selected and which sampling frame was needed.

(e) Sampling – interview should be trained in the basic principles of sampling and, in particular, they should be told about the various sources of sampling bias which exist.

(f) Administrative details.

iii) For home interviews and some other interviewing surveys, the respondents should always be informed, by letters or handouts, how they are chosen, whether co-operation is voluntary, the purpose of the survey, who it is for, what confidentiality arrangements apply, and where to make enquiries.

1.3.5.2 Operation Manuals

i) It is important that all general instructions be put on paper and that an efficient records system be established.

ii) The most important of these instructions is the "interviewers' manual". It must be prepared in a form parallel to the questionnaire to be used and should be modified as field testing reveals the need for changes in the questionnaire and other instructions. As for other field workers involving no direct interview, the exact procedures for obtaining the data required should instead be written down in the manual.

iii) At an early stage of planning, various definitions to be used in the survey must be decided upon as a result of existing knowledge and these must also be repeatedly tested in the field. Definitions used in other countries may be referenced but the final definitions to be adopted must satisfactorily fit local conditions. These definitions must then be used during all trainings and checks made during interviewing and processing to see that they are being correctly applied.

iv) Most surveys must also utilize a supervisors' manual outlining the duties of supervisors and explaining problems they may encounter.

1.3.5.3 Quality Control

i) In one sense, quality control is an aspect of administrative control. But the term here refers largely to the activities at the interviewing or data collection site that ensure a satisfactory survey. Quality control is mainly achieved by the following methods:

(a) continued training of field workers and supervisors

(b) checking of completed field work by supervisors

(c) supervisors inspecting every stage of field work and knowing clearly what is going on

(d) supervisors checking some of the interviewing result by re-interviewing

(e) supervisors observing some of the work of the field workers

(f) encouraging continuous team discussion on all aspects of the work

1.3.5.4 Pre-tests and Pilot surveys

i) From what have been mentioned so far, it is clear that a number of things need to be known before an efficient survey can be planned. Where historical data or prior experience is not available, the best way of acquiring this knowledge is by undertaking a small survey, known as a pre-test or pilot survey. This takes the form of firstly a series of small pre-tests on isolated problems of the design. When the broad plan of the enquiry is established, a pilot survey, which is a small-scale replica of the main survey, can be conducted.

ii) Specifically, a pilot survey will provide guidance on:

(a) The adequacy of the sampling frame from which it is proposed to select the sample.

(b) The variability (with regard to the subject under investigation) within the population to be surveyed.

(c) The non-response rate to be expected.

(d) The suitability of the data collection method.

(e) The adequacy of the questionnaire or data collection form.

(f) The efficiency of the instructions and general briefing of interviewers or field workers.

(g) The choice of codes chosen for pre-coded questions.

(h) The probable cost and duration of the main survey and of its various stages.

(i) The efficiency of the organization in the field, in the office and in the communication between the two.

1.3.6 Data Processing

1.3.6.1 Before the questionnaires or data collection forms can be regarded as ready for coding, tabulation and analysis, they should be checked in the office for completeness, accuracy and uniformity. The first point to check is that there is an answer to every questions as for a questionnaire or a data item for every entry in a data collection form. It is not enough to check that all questions are answered or all data entries have been filled by the field workers, one must also try to check whether there are obvious inconsistencies in the data entries. The editing stages also give an opportunity for checking that all interviewers or field workers have interpreted the questions and instructions uniformly.

1.3.6.2 For most questionnaire surveys, certainly whenever results are to be put in quantitative form, the intermediate stage is the coding of the answers. Sometimes this and the initial editing stage are joined in a single operation. The process involves two distinct steps. The first is to decide on the categories to be used, the second to allocate individual answer to them. The set of coding frames covering all the information to be abstracted from the questionnaire is usually documented as a coding manual.

1.3.6.3 In the majority of surveys, the data, once edited and coded, are put together, probably with some computational work, in some kind of tables and may then also undergo some other forms of statistical analysis. This process is quite a straightforward one involving simple computational work and the counting of number of cases falling into each of several classes. The process can be done manually or by computer. Although hand tabulation can in principle be used in any surveys, in practice, because of its tedious nature, slowness and liability to errors, it is mainly restricted to simple situations.

1.3.6.4 For surveys which involves large number of data records or for which many cross-tabulations are required, computer analysis is almost invariably the right way to proceed. Moreover, the availability of a large number of standard statistical packages in a computer environment also greatly facilitates the carrying out of tabulation and statistical analyses by computer.

1.3.6.5 If dedicated microcomputers are available, the data processing operation can be performed in-house easily. However, if a much more powerful computing environment is required, other processing support from the Government Data Processing Agency or from the Census & Statistics Department can be sought. For the latter case, data processing support is provided for statistical applications only.

1.3.7 Analysis, Interpretation and Presentation of Survey Results

1.3.7.1 After the data obtained from a survey have been edited, coded and tabulated, what follows is in many ways the most skilled task of all, the analysis and interpretation of the results. Certainly, it is a task calling for the researcher's own judgement and skill, particularly a thorough knowledge of the subject matter under investigation. Thus these final stages of a survey are the least easy to provide guidance in general terms. The range of statistical methods and techniques applicable in survey analysis is too large to be presented in a manual like this one. It is therefore advisable for a researcher to consult either a statistical textbook or a professional statistician in order to enable him to select the right techniques for analysing the survey results.

1.4 Evaluation of Survey Accuracy

1.4.1 General

1.4.1.1 To be useful, a statistics needs to be sufficiently reliable to serve the particular needs. No overall criterion of reliability applies to all surveys since the margin of error that can be tolerated in a study depends on the actions or recommendations that will be influenced by the data. These factors will initially affect the sample size, the design of the questionnaires, the effort put into training and supervising the interviewers, field workers, supervisors and so on. Estimates of error also need to be considered in analysing and interpreting the results of the survey. Computational formulae for the determination of sample size are introduced in the Appendix V.

1.4.1.2 In evaluating the accuracy of a survey, it is convenient to distinguish two sources of errors, i.e. sampling errors and non-sampling errors.

1.4.2 Sampling Errors

1.4.2.1 Good survey practice includes calculation of sampling errors, which is possible if probability methods are used in selecting the sample. Furthermore, information on sampling errors should be made readily available to all users of the statistics. If the survey results are published, data on sampling errors should be included in the publication.

1.4.2.2 There are a number of ways of describing and presenting data on sampling errors so that users can take them into account. The direct measure of the sampling error of a statistics derived from a sample survey is the variance of that statistics. Different sample designs will give different variances for a statistics. Details of the computational formulae for the variances of a statistics for the different sample designs have already been given in Sections 1.3.4.4 to 1.3.4.8. The smaller in value the variance of a statistics is, the more precise that statistics will be. Another measure of sampling error is the standard error which is simply the square root of the corresponding variance.

1.4.2.3 Another way of presenting sampling errors is by the construction of confidence intervals for statistics computed from a sample survey.
Let $\bar{y}$ be a sample statistics
se($\bar{y}$) be the standard error of $\bar{y}$
Then by the Central Limit Theorem, $\bar{y}$ will have a normal distribution for sufficiently large sample size

- The interval y ± k se($\bar{y}$) is then called a confidence interval based on the estimate $\bar{y}$, which is an unbiased estimate for the population value. Different values of k will correspond to different probability that this interval will contain the true population value. The probability values for some common values of k is given as follows: -

k	Probability level
1.00	68%
1.96	95%
3.00	99.7%

- For example, the interval y ± 1.96 se($\bar{y}$) is then called a 95% confidence interval based on the sample estimate $\bar{y}$ since the probability that this interval will contain the true population value is 0.95. More details of the different k values and their corresponding probability levels can be found in a normal distribution table in most statistics textbooks. In case the sample size is too small (less than 30) for the Central Limit Theorem to be valid, the t-distribution instead of the normal distribution should then be used.

1.4.3 Non-sampling Errors

1.4.3.1 Unlike sampling errors, there is no simple and direct method of estimating the size of non-sampling errors. In most surveys, it is not practical to measure the possible effect on the statistics of the various potential sources of error. By examining the procedures and operations of a specific survey, experienced survey statisticians may sometimes be able to assess its quality. However, in most cases, one can only state that, for example, the errors are probably relative small and will not affect most conclusions drawn from the survey, or that the errors may be fairly large and inferences have to be made with caution.

1.4.3.2 Non-sampling errors are often non-random in nature and will therefore lead to systematic biases in the survey results. In fact, biases can arise from any aspect of the survey operation. In order to ensure the usefulness of the survey results, care must be taken to eliminate the sources of bias as far as possible. Some of the main contributing causes of bias are:

(a) There may be errors in the sample selection process or part of the population may be omitted from the sampling frame.

(b) Information is generally obtained for only part of the sample. Frequently, there are differences between the non-interview population and those interviewed.

(c) Sometimes respondents cannot be interviewed and information is obtained about them from others, but the proxy respondent is not always as knowledgeable about the facts.

(d) Some respondents may not understand what is wanted.

(e) Respondents in some case do not know the information or do not try to obtain the correct information. They may even conceal the truth out of fear or suspicion of the survey.

(f) The questions may be worded to influence the respondents to answer in a specific way.

(g) There may be systematic measurement errors due to machine failure or human factors.

(h) There may be processing errors in the coding, punching and computer processing of the data.

(i) There may be differences between what is desired and what the survey actually covers.

(j) Interviewers may misread the question or twist the answers in their own words and thereby introduce bias.

1.4.3.3 Obviously, each survey is not necessarily subject to all these sources of error. However, all these possibilities should be explored in planning a survey and preventive measures should be introduced to keep these errors as small as possible.

Appendix I

Mean and Variance for Simple Random Sampling

Let N = number of elements in the population

Y_i = value of ith element

Y = population total = $\sum Y_i$

$\bar{Y}$ = population mean = $\sum Y_i/N$

S_y^2 = variance of population element

$$= \frac{1}{N}\left[\sum \left(Y_i - \bar{Y}\right)^2\right]$$

$$= \frac{1}{N}\left[\sum Y_i^2 - \frac{\left(\sum Y_i\right)^2}{N}\right]$$

n = sample size

y_i = value of ith element in the sample

y = sample total = $\sum y_i$

$\bar{y}$ = sample mean = $\sum y_i/n$

s_y^2 = element variance

$$= \frac{1}{n-1}\left[\sum \left(y_i - \bar{y}\right)^2\right]$$

$$= \frac{1}{n-1}\left[\sum y_i^2 - \frac{\left(\sum y_i\right)^2}{n}\right]$$

f = sampling fraction = n/N

	Population Value	Estimator	Variance
(a) mean	$\bar{Y}$ = Y/N	y = y/n	$\text{var}(\bar{y}) = \frac{1-f}{n} S_y^2$
(b) ratio	R = Y/X	r = y/x	$\text{var}(r) = \frac{(1-f)n}{x^2(n-1)}\left[\sum Y_i^2 - 2r\sum x_i y_i + r^2 \sum x_i^2\right]$

where X is another random variable similar to y

Example

A simple random sample of n=100 households were selected from a total of N=10,000 households in a survey.

Let y_i = no. of private cars owned by household i
x_i = no. of persons in household i

we want to estimate the average car owning rate per household and per population. From the survey, we have $\sum y_i = 20, \sum x_i = 320, \sum y_i^2 = 24, \sum x_i^2 = 1180, \sum x_i y_i = 66$

(a) Average car owning rate per household = $\bar{y}$ = $\sum y_i/n = 20/100 = 0.2$

$$\text{var}(\bar{y}) = \frac{1-f}{n} s_y^2 = \frac{1-n/N}{n(n-1)}\left[\sum y_i^2 - \frac{(\sum y_i)^2}{n}\right]$$

$= [(1 - 0.01) / (100)(99)] [24 - (20)^2 / 100]$

$= 0.0001 (20)$

$= 0.002$

(b) Average car owning rate per population = $r = \sum y_i / \sum x_i = 20 / 320 = 0.0625$

$$\text{var}(r) = \frac{(1-f)n}{(\sum x_i)^2 (n-1)}\left[\sum y_i^2 - 2r\sum x_i y_i + r^2 \sum x_i^2\right]$$

$$= \frac{(1-0.01)(100)}{(320)^2 (99)}\left[24 - 2(0.0625)(66) + (0.0625)^2 (1180)\right]$$

$= 0.9766 * 10^{-5} (20.3594)$

$=1.988*10^{-4}$

Appendix II

Mean and Variance for Stratified Element Sampling

Let
- H = total number of stratum
- N_h = number of elements in the population of the h^{th} stratum
- n_h = number of elements in the sample of the h^{th} stratum
- Y_{hi} = value of the i^{th} element in the h^{th} stratum
- y_{hi} = value of the i^{th} element in the sample of the h^{th} stratum
- $N = \sum N_h$ $\quad$ $n = \sum n_h$
- $W_h = N_h/N$
- $f_h = n_h/N_h$ $\quad$ $F_h = N_h/n_h$

	Population Value	Estimator	Variance
(a) Mean	$\bar{Y} = \sum W_h \bar{Y}_h$	$\bar{y} = \sum W_h \bar{y}_h$	$Var(\bar{y}) = \sum W_h^2 \, \mathrm{var}(\bar{y}_h) = \sum W_h^2 \frac{(1-f_h)}{n_h} s_h^2$ where $s_h^2 = \frac{1}{n_h - 1}\left[\sum y_{hi}^2 - \frac{(\sum y_{hi})^2}{n_h}\right]$
(b) Ratio	$R = \frac{\sum Y_h}{\sum X_h}$	$r = \frac{\sum F_h y_h}{\sum F_h x_h} = \frac{\sum y_h'}{\sum x_h'} = \frac{y'}{x'}$	$\mathrm{Var}(r) = \frac{1}{x'^2}\left[\sum \mathrm{var}(y_h') + r^2 \sum \mathrm{var}(x_h') - 2r \sum \mathrm{cov}(y_h', x_h')\right] = \frac{1}{x'^2}\left[\sum d^2 y_h' + r^2 \sum d^2 x_h' - 2r \sum dy_h' dx_h'\right]$ where $d^2 y_h' = \frac{1-f_h}{n_h - 1}\left(n_h \sum y_{hi}'^2 - y_h'^2\right)$, $d^2 x_h' = \frac{1-f_h}{n_h - 1}\left(n_h \sum x_{hi}'^2 - x_h'^2\right)$, $dy_h' dx_h' = \frac{1-f_h}{n_h - 1}\left(n_h \sum y_{hi}' x_{hi}' - y_h' x_h'\right)$

Example

Let us use the same example as in Appendix I. However, instead of selecting a SRS, we will divide the 10,000 households into 2 strata, namely a high income household stratum with N1 = 2,000 and a low income household stratum with N_2 = 8,000. Now we will select n_1 = 20 households from stratum I and n_2 = 80 households from stratum 2.

Let y_{hi} = no. of private cars owned by household i in stratum h

x_{hi} = no. of persons in household i in stratum h

From the survey, we have $\sum y_{1i} = y_1 = 9$, $\sum y_{2i} = y_2 = 11$,

$$\sum y_{1i}^2 = 11, \quad \sum y_{2i}^2 = 13, \quad \sum x_{1i} = x_1 = 53, \quad \sum x_{2i} = x_2 = 267,$$
$$\sum x_{1i}^2 = 163, \quad \sum x_{2i}^2 = 1017, \quad \sum y_{1i} x_{1i} = 30, \quad \sum y_{2i} x_{2i} = 368$$

(a) Average car owning rate for household = $\bar{y}$

$$= \sum w_h \bar{y}_h = w_1 \bar{y}_1 + w_2 \bar{y}_2$$
$$= \frac{2{,}000}{10{,}000}\left(\frac{\sum y_{1i}}{n_1}\right) + \frac{8{,}000}{10{,}000}\left(\frac{\sum y_{2i}}{n_2}\right) = 0.2\left(\frac{9}{20}\right) + 0.8\left(\frac{11}{20}\right)$$
$$= \underline{\underline{0.2}}$$

$$\text{var}\left(\bar{y}\right) = \sum w_h^2 \,\text{var}\left(\bar{y}_h\right)$$
$$= w_1^2 \frac{(1-f_1)}{n_1(n_1-1)}\left[\sum y_{1i}^2 - \frac{\left(\sum y_{1i}\right)^2}{n_1}\right] + w_2^2 \frac{(1-f_2)}{n_2(n_2-1)}\left[\sum y_{2i}^2 - \frac{\left(\sum y_{2i}\right)^2}{n_2}\right]$$
$$= \frac{(0.2)^2(1-0.01)}{20(20-1)}\left[11 - \frac{9^2}{20}\right] + \frac{(0.8)^2(1-0.01)}{80(80-1)}\left[13 - \frac{11^2}{80}\right]$$
$$= (0.0001042)(6.95) + (0.00010025)(11.4875)$$
$$= \underline{\underline{0.00188}}$$

b) Average car owning rate per population = r = $\sum y_h / \sum x_h$ = (9+11)/(53+267)

= 0.0625

$$\text{var}(r) = \frac{1}{\left(\sum x_k\right)^2}\left[\sum d^2 y_k + r^2 \sum d^2 x_k - 2r \sum dy_k dx_k\right]$$

$$\left(\sum x_k\right)^2 = (x_1 + x_2)^2 = (53 + 267)^2 = (320)^2 = 102{,}400$$

where

$$d^2 y_1 = \frac{1 - f_1}{n_1 - 1}\left(n_1 \sum y_{1i}^2 - y_1^2\right) = \frac{1 - 0.01}{(20 - 1)}\left[20(11) - (9)^2\right] = 7.24263$$

$$d^2 y_2 = \frac{1 - f_2}{n_2 - 1}\left(n_2 \sum y_{2i}^2 - y_2^2\right) = \frac{1 - 0.01}{(80 - 1)}\left[80(13) - (11)^2\right] = 11.51658$$

$$\sum d^2 y_h = 7.24263 + 11.51658 = 18.75921$$

$$d^2 x_1 = \frac{1 - f_1}{n_1 - 1}\left(n_1 \sum x_{1i}^2 - x_1^2\right) = \frac{1 - 0.01}{(20 - 1)}\left[20(163) - (53)^2\right] = 23.49947$$

$$d^2 x_2 = \frac{1 - f_2}{n_2 - 1}\left(n_2 \sum x_{2i}^2 - x_2^2\right) = \frac{1 - 0.01}{(80 - 1)}\left[80(1017) - (267)^2\right] = 126.20620$$

$$\sum d^2 x_h = 23.49947 + 126.20620 = 149.70567$$

$$dy_1 x_1 = \frac{1 - f_1}{n_1 - 1}\left(n_1 \sum y_{1i} x_{1i} - y_1 x_1\right) = \frac{1 - 0.01}{(20 - 1)}\left[20(30) - (9)(53)\right] = 6.40895$$

$$dy_2 x_2 = \frac{1 - f_2}{n_2 - 1}\left(n_2 \sum y_{2i} x_{2i} - y_2 x_2\right) = \frac{1 - 0.01}{(80 - 1)}\left[80(36) - (11)(267)\right] = -0.71430$$

$$\sum dy_h x_h = 6.40895 - 0.71430 = 5.69465$$

$$\text{var}(r) = \frac{1}{102400}\left[18.75921 + (0.0625)^2 (149.70567) - 2(0.0625)(5.69465)\right]$$

$$= \frac{18.6322}{102400} = \underline{1.82 * 10^{-4}}$$

Appendix III

1.4.1 Mean and Variance for Cluster Sampling

Let $Y_{\alpha\beta}$ = value of the β^{th} element in the α^{th} cluster
$y_{\alpha\beta}$ = value of the β^{th} element in the sample in the α the cluster
A = number of cluster in the population
a = number of cluster in the sample
N_α = total number of elements in cluster α
n_α = number of sampled elements in cluster α

Assume that the selection of clusters is by SRS with overall equal probability of selection for all sample elements

	Population Value	Estimator	Variance
a) mean	$\bar{Y} = \frac{Y}{X}$ $= \frac{1}{X}\sum\sum Y_{\alpha\beta}$ $= \frac{\sum\sum Y_{\alpha\beta}}{\sum\sum X_{\alpha\beta}}$ $\alpha = 1,\ldots, A$ $\beta = 1,\ldots, N_\alpha$	$r = \frac{y}{x}$ $= \frac{1}{x}\sum\sum y_{\alpha\beta}$ $= \frac{\sum\sum y_{\alpha\beta}}{\sum\sum x_{\alpha\beta}}$ $\alpha = 1, \ldots, a$ $\beta = 1, \ldots, n_\alpha$	Var(r) $= \frac{1-f}{a}\frac{a}{a-1}$ $\left[\sum y_\alpha^2 + r^2\sum x_\alpha^2 - 2r\sum y_\alpha x_\alpha\right]$

where X is a counting variable
i.e. $X_{\alpha\beta} = 1$ for every $\alpha\beta$
f is the sampling fraction = f_a * f_b
where f_a = sampling fraction for clusters
f_b = sampling fraction for elements within a cluster

(b) ratio

All the estimator and variance formula are the same as above except that $X_{\alpha\beta}$ will now be another random variable similar to $Y_{\alpha\beta}$

Example

There are 15 secondary schools in a city. A survey was conducted to estimate the average daily travelling expenses for student in the city. A cluster sample with overall equal probability of selection for the students was used. An overall sampling fraction of 0.1 was to be maintained. 3 schools were selected at the first stage. Students were then selected within each of the selected schools. The data collected from the students are as follows:

	School 1	School 2	School 3
Total Number of Student (N_α)	6	6	8
Number of Students Selected (n_α)	3	3	4
Sampling Fraction for Schools (f_a)	0.2	0.2	0.2
Sampling Fraction for Students (f_b)	0.5	0.5	0.5
Overall Sampling Fraction (f)	0.1	0.1	0.1
Daily Travelling Expenses for Students Selected ($) ($y_{\alpha\beta}$)	1.3, 2.2, 3.5	1.5, 1.8, 2.9	2.7, 3.2, 4.2, 3.2
y_α	7.0	6.2	13.3
y_α^2	49.0	38.44	176.89
x_α	3	3	4
x_α^2	9	9	16

$$\sum y_\alpha = 26.5,\ \sum x_\alpha = 10,\ \sum y_\alpha^2 = 264.33,\ \sum x_\alpha^2 = 34,\ \sum y_\alpha x_\alpha = 92.8$$

(a) average daily travelling expenses $= r = \dfrac{\sum y_\alpha}{\sum x_\alpha} = \dfrac{26.5}{10} = \underline{\underline{2.65}}$

(b) $\text{var}(r) = \dfrac{1-f}{x^2}\dfrac{a}{a-1}\left[\sum y_\alpha^2 + r^2\sum x_\alpha^2 - 2r\sum y_\alpha x_\alpha\right]$

$= \left(\dfrac{1-0.1}{10^2}\right)\left(\dfrac{3}{2}\right)\left[264.33 + (2.65)^2(34) - 2(2.65)(92.8)\right]$

$= 0.0135 * \left[264.33 + 238.765 - 491.84\right]$

$= 0.0135 * 11.255$

$= \underline{\underline{0.1519}}$

Appendix IV

Mean and Variance for Replicated Sampling

Let z_i be the estimate for the i^{th} sub-sample and the overall estimate is $\bar{z} = \frac{1}{c}\sum z_i$ where c is the number of independent sub-samples.

Then $\text{var}(\bar{z}) = \frac{1}{c(c-1)}\sum (z_i - \bar{z})^2 = \frac{1}{c(c-1)}\left[\sum z_i^2 - \frac{(\sum z_i)^2}{c}\right]$

This formula applies irrespective of the form of sampling procedure employed in the sub-samples.

Example

In a household survey to estimate the average household income in the Territory, instead of selecting a single sample of 10,000 households, five sub-samples each of 2,000 households were selected. The average household income (Z_i) obtained from these five sub-samples are respectively \$7,200, \$7,450, \$6,900, \$6,850 and \$7,350

(a) Average household income = $\bar{z}$

$= (7200 + 7450 + 6900 + 6850 + 7350)/5$

$= 7150$

(b) $\text{var}(\bar{z}) = \frac{1}{5(5-1)}\left[255,897,500 - \frac{1,278,062,500}{5}\right]$

$=285,000/20$

$=14,250$

Appendix V

Computational Formulae for the Determination of Sample Size

I) For SRS design

Let $\bar{y}$ be the sample mean

n be the sample size

se($\bar{y}$) be the standard error of the sample mean $\bar{y}$

then $se^2(\bar{y}) = \frac{1-f}{n} S_y^2$

where 1 - f is the finite population correction usually ignored for approximation purpose

$S_y^2 = \frac{1}{n-1}\sum (y_i - \bar{y})^2$

therefore $n = \frac{S_y^2}{se^2(\bar{y})}$ or $n = \frac{S_y^2/\bar{y}^2}{se^2(\bar{y})/\bar{y}^2} = \frac{C_y^2}{CV^2(\bar{y})}$

where C_y^2 is called the element coefficient of variation

$CV^2(\bar{y})$ is called the coefficient of variation of the mean $\bar{y}$

For a survey, $CV(\bar{y})$ is determined based on the precision level of $\bar{y}$ required while C_y is estimated from past surveys or from other surveys.

II) For other design

For any other design D, define the design effect for D as

$Deff_D = var(\bar{y})_D / var(\bar{y})_{SRS}$ for the same sample size n

In general, for all other sample design, the variance for that design can be written in the following form:-

$$var(\bar{y})_D = \frac{1-f}{a} S_g^2$$

where a is the number of units

S_g^2 is the unit variance

Then the same procedure for determining the sample size a as for a SRS design above can then be adopted.

In case the measure of unit in a design is the same as that for a SRS design, the sample size n can also be determined by making use of the $Deff_D$.

i.e. $Deff_D = \frac{var(\bar{y})_D}{var(\bar{y})_{SRS}} = \frac{(1-f)S_g^2/n}{(1-f)S_y^2/n} = \frac{S_g^2}{S_y^2}$ for the same n

Now for a sample design D having a sample size n_D to have the same variance as for a SRS design, we would have approximately:

$$\frac{S_g^2}{n_D} = \frac{S_y^2}{n_{SRS}}$$

$$n_D = n_{SRS} \times \frac{S_g^2}{S_y^2}$$

$$= n_{SRS} \times Deff_D$$

where n_{SRS} can be estimated as in (I) above and $Deff_D$ can be estimated from the past surveys or by experience.

Example

A survey is to be designed in a country to estimate the average daily travelling expenses for secondary school students. A similar survey -.. has been conducted previously on a sample of 5000 students in a cluster sampling design with equal probability of selection for students. A total of 10 schools were selected. The estimated sampling variance from this survey was $var(\bar{y})$ = 0.01 with Deff = 1.75. The element variance S_y^2 was estimated to be 28.57. The average travelling expenses for this time of the survey is expected to be \$2.0 based on results of the previous survey. How large a sample is needed this time to achieve a $cv(\bar{y})$ = 0.03.

(a) The sample size can be determined by the simple method as follows:

$$var(\bar{y}) = 0.01 = \frac{1-f}{a} S_g^2 \cong \frac{S_g^2}{a} \text{ (ignore 1- f for approximation)}$$

$$S_g^2 = 0.01 * a = 0.01 * 10 = 0.1$$

for the new round of survey $cv^2(\bar{y}) = (0.03)^2 = 0.0009 = \frac{se^2(\bar{y})}{\bar{y}^2}$

$var(\bar{y}) = se^2(\bar{y}) = 0.0009 \times (2)^2 = 0.0036$

by making use again $var(\bar{y}) = \frac{S_g^2}{a}$

$$a = \frac{S_g^2}{var(\bar{y})} = \frac{0.1}{0.0036} = 28$$

about 28 schools have to be selected and within each of these, 500 students have to be selected, implying a total sample size of 14,000

(b) The sample size can also be determined by making use of Deff

$$C_y^2 = \frac{S_y^2}{\bar{y}^2} = \frac{28.57}{2^2} = 7.143$$

$$n_{SRS} = \frac{C_y^2}{cv(\bar{y})} = \frac{7.143}{(0.03)^2} = 7937$$

$$n_D = n_{SRS} * Deff = 7937 * 1.75 = \underline{\underline{13890}}$$

With about 500 students to be selected within each school, therefore a total of about 28 schools have to be selected.

TPDM Volume 8 Chapter 2 – The Annual Traffic Census

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2.2 Introduction

2.2.1 General

2.2.1.1 A knowledge of the characteristics of traffic flows and compositions on different parts of the road network is essential for a proper understanding of its functions and performance. This can be achieved through the collection of traffic flow and composition data on a large scale as carried out in the Annual Traffic Census.

2.2.1.2 Basically, the Annual Traffic Census is a continuing programme of regular observation of road traffic conditions. As it is virtually impossible to record traffic flow data at all road links all the time, a sampling process involving selection in location as well as in time is required. Consequently, the Annual Traffic Census aims at measuring traffic flow condition and providing traffic and transport statistics within acceptable precision levels at a reasonable cost.

2.2.2 Functions of the Traffic Census System

2.2.2.1 In general, the basic functions of the Annual Traffic Census are as follows:-

(i) To estimate the amount of travel in terms of vehicle-kilometres in respect of major and minor road networks in the territory.

(ii) To monitor the trend in traffic by type of station, class of road and type of vehicle.

(iii) To examine the variability of traffic flow pattern (hourly, daily and monthly).

(iv) To provide estimates of traffic flow based on sample measurement on individual links of major network.

(v) To monitor traffic flowing across screenlines and cordons in terms of volumes of vehicle and passenger trips by type of vehicle and time of day.

2.2.3 Design of the Traffic Census System

2.2.3.1 Different Surveys designs can be adopted for the ATC to meet the functions stipulated. They differ in cost, complexity and hence level of precision that can be attained. The organisation and design of the approach now used are described in Section 2.3.

2.2.3.2 In 1988, a new methodology was adopted and fully implemented to cover the whole territory beginning from the year 1989. The statistical methods employed in the new methodology enable the computation of error margins for the various estimates of traffic flows.

2.2.3.3 In 1999, a comprehensive review on the design of the Traffic Census System was carried out and a pilot scheme on the newly proposed methodology would be put on trial on Hong Kong Island prior to full implementation.

2.3 Organisation of the Annual Traffic Census System

2.3.1 General

2.3.1.1 The collection of traffic flow data is increasingly labour intensive and expensive with the expansion of the road network. To conduct and report the Annual Traffic Census in a more cost effective and efficient manner, it is essential that the results obtained can be generalized to locations other than those at which full observations are made. This can be achieved if the framework of the Annual Traffic Census is designed with due regard to statistical requirements. The Annual Traffic Census is hence based on a probability sampling design.

2.3.1.2 Apart from obtaining a more economical use of traffic data, there is a need to have a traffic data system closely associated with road characteristics. The benefit of having a closely integrated traffic and road data bank is to facilitate analysis in a greater dimension and to extend the scope of usage of available information. It is hence necessary to examine the Annual Traffic Census system from two perspectives, viz. road inventory and Surveys design.

2.3.2 Road Inventory

2.3.2.1 The Annual Traffic Census does not cover the whole road network, and specifically, those restricted and low-volume roads in both urban and rural areas are excluded.

2.3.2.2 The road links covered in the Annual Traffic Census are classified as major and minor, basically distinguished in terms of traffic flow volume. The road network of the Hong Kong Comprehensive Transport Study (CTS) provides a convenient frame for the major links whilst the remainder of the ATC links constitute the Minor Link Network.

2.3.2.3 To facilitate analysis of traffic data in conjunction with road characteristics, consideration is given to including the following attributes in the road inventory: -

(i) link number/station number

(ii) location

(iii) road type

(iv) link capacity

(v) direction

(vi) type of carriageway

(vii) number of lanes

(viii) length and width

(ix) group type (see Section 2.3.3)

(x) restriction e.g. urban clearway

(xi) speed limit

(xii) stratum number

2.3.3 Grouping of Major Links

2.3.3.1 Sites at different locations can be identified to display similar traffic patterns and variations regardless

of the total traffic flow. Thus, based on some identified factors such as the functional use, links can be categorized into groups such that the average characteristics of links within the same group can be taken as typical of the group. Links which are categorized as elements of the group would assume these typical characteristics.

2.3.3.2 The primary objective of grouping the major links is to establish group scaling factors for the estimation of annual average daily traffic (AADT) from a short-period (1-day or 1-week) count. Thus, the AADT of a particular site can be obtained by multiplying the observed short-period count by the group scaling factor pertaining to the appropriate day of the week and month of the year.

2.3.3.3 Multivariate techniques can be employed to assign the links to a number of groups by examining some traffic flow characteristics at each link in respect of a predefined similarity measure. For instance, the 84 ratios (12-month by 7- weekday of (KAADT / KXD,M)
where $K^{X}D,M$ is the traffic flow for the Dth day of the week in the Mth month at the Kth link and K^{AADT} is the average annual daily traffic at the Kth link can be examined in relation to a similarity measure defined for two links K and K' as

$$d'_{KK} = \sum_{M=1}^{12} \sum_{D=1}^{7} \left[\left(\frac{K^{AADT}}{K^{X}D}, M \right) - \left(\frac{K'^{AADT}}{K'^{X}D}, M \right) \right]^2$$

Thus each link is assigned to the same group with one other link such that the value d_{KK}' is minimized. Where the two links have affinity over others, they are first put in the same group and their values are averaged such that the whole procedure can be repeated until the required number of groups is formed or the merging of additional groups would significantly decrease the homogeneity of the characteristics of links in the group.

2.3.3.4 The above procedure would be extremely tedious and time-consuming if the number of links is large. An alternative, which is easy to work with, is to group the links by some predetermined criteria and examine the similarity measure within each group. If, for instance, the maximum and minimum factors differ by say 0.1 within each group, then the results are considered satisfactory and the grouping is adopted. Some of the criteria that can be considered for assigning links to groups are listed as follows: -

(i) location;

(ii) type of road;

(iii) function class of road (e.g. commuting and recreational).

2.3.4 Types of Counting Stations in the Major Link Network

2.3.4.1 In view of the large number of links in the Major Link Network, it is prohibitive as far as resources available are concerned to collect traffic flow data at every link. This constraint leads to the set-up of a small number of core stations at some randomly selected links supplemented by a much greater number of coverage stations established elsewhere in the network.

2.3.4.2 Detailed traffic flow data are collected at the selected core stations. The hourly, daily and monthly traffic variations are then established. In addition, the core stations are assigned to different groups as described in Section 2.3.3 and scaling factors to convert short-period count to AADT are constructed for the various groups.

2.3.4.3 The coverage stations serve a "benchmark" function and furnish short-period counts. Using the appropriate group scaling factor, short-period count at a coverage station can be converted to AADT.

2.3.4.4 Apart from the core and coverage stations, additional locations are required for traffic counting. For example, traffic flows in and out of a cordoned area or crossing strategic screenlines are needed for transport and traffic studies and newly built roads that intersect with strategic screenlines. Ad hoc traffic counts beyond the scope of the Annual Traffic Census may also be needed for answering

queries, monitoring new traffic management scheme, etc.

2.3.4.5 As the traffic flows recorded at various types of traffic count stations are put to different uses, the Surveyss should be designed to meet their respective objectives. A core census based on a stratified systematic approach is designed for the core stations. As the number of coverage stations is likely to be very large and there is a need to have traffic counts at all these locations, though this does not have to be at the same time, a rotation design with traffic counts collected at every link over a cycle of a number of years is appropriate for these stations. Regarding the additional stations other than the core and coverage stations, the collection of traffic flow data may vary, depending on the purpose or the way data collected will be put to use.

2.3.5 Surveys of the Core Stations in the Major Link Network

2.3.5.1 The traffic flow data collected at core stations should be used for:-

(i) Monitoring the hourly, daily and monthly traffic pattern and variation.

(ii) Monitoring group scaling factors irrespective of total flows to convert short-period counts, particularly those obtained at coverage stations, to a daily, weekly, monthly average or the annual average daily traffic (AADT) .

(iii) Monitoring the annual, and preferably also the quarterly, trend of travel by road class and/or vehicle type.

(iv) Providing, if resources are available, estimates on traffic characteristics such as speed and axle-weight by road class and/or vehicle type.

2.3.5.2 The Surveys of the core stations covers the whole Major Link Network. Each of the links in the Major Link Network is the sampling unit and a number of these links are to be selected randomly. Traffic counts or other characteristics are recorded at these selected links every year. If necessary, some of these chosen links can be replaced by others using a random approach.

2.3.5.3 The design of the sample plays an important role in the validity and precision of the Surveys results. A simple random sampling approach, in which the sampling unit is directly selected with equal probability such that no unit can appear more than once in the sample is easy to work with. However, to reduce the play of chance on sample composition and increase precision of the estimates, stratification approach is a better alternative. Thus, before the selection actually takes place, the sampling units are first stratified into different strata according to some criteria or factors and then within each stratum, the samples are selected in a random manner. In this case, geographical area, traffic volume, type and length of road can be considered for use as stratification factors.

2.3.5.4 The estimates are subject to both non-sampling and sampling errors. Whilst the former is difficult, if not impossible, to estimate, the latter can be stated in terms of the 95% confidence interval as an indication of the level of precision attained. When considering the level of precision to be achieved, it should be borne in mind that doubling the precision would require roughly the resources to be increased four-fold. Thus the target precision should be set at a realistic level within the constraint of available resources.

2.3.5.5 There is no hard and fast rule on the level of precision adopted. In general, it is desirable to obtain traffic flow estimates with a 95% confidence interval of ±10%. However, for road sections of low traffic volumes, a greater margin of error is considered tolerable.

2.3.5.6 The number of links to be selected in the core census depends primarily on resources available and the level of precision required. Having decided on the total number of core stations, the allocation of core stations in the various strata is proceeded in a way such that the precision of the overall estimate is maximized. For instance, to facilitate the monitoring of trend in the amount of travel, a quasi-optimal allocation is to assign links per unit length of road to each stratum according to their respective average flows.

2.3.5.7 In view of the relatively enormous resources required for each core station, the sample size is largely determined on practical consideration and users' area of interest initially. The determination of the sample size and its allocation are to be reviewed once more resources and information on the variability of estimates are available.

2.3.5.8 As it is impossible to obtain separate traffic flow data at each section of the road system at all times, traffic counts can only be obtained at some selected locations. The sites are selected through a random process and the estimation procedure adopted should be in line with the design. It is through the random selection procedures that estimates obtained are unbiased and the level of precision of the estimates can be specified.

2.3.5.9 Having decided on the number of core stations of each stratum, it is necessary to locate the core stations through a random process. The grid system of locating and selecting links is not recommended as it is operationally tedious to work with a large number of links within a cell in the grid system. An alternative is to select sites with probability proportional to the length of links. The approach is briefly described as follows:-

(i) The various links of the Major Link Network of known lengths in each stratum are listed in any convenient order, say alphabetically and the cumulative length of the links is appended to the list.

(ii) Divide the total length by the number of sites to be selected to obtain the interval.

(iii) Choose a random number between 0 and the interval.

(iv) Select the road link with its associated cumulative length containing the chosen random number.

(v) Henceforth, select locations n (n = 1, 2, 3,) intervals down the list of cumulative link lengths starting from the random start.

(vi) In cases where a non-integral interval is obtained, techniques such as circular list or fractional intervals can be employed.

(vii) The final location in each selected road link is determined with consideration to safety and operational difficulties.

2.3.5.10 Desirably, continuous traffic counts should be recorded throughout the year at the core stations, however the large resources that would be required to achieve this makes this approach impracticable.

A less ambitious design which is more acceptable is where traffic counts are collected for one week per month for 12 months using recording counters. The week selected for traffic counting should be a 'normal' one without Public Holiday(s) and adverse weather condition. The trade-off for adopting the less expensive approach is:-

(i) travel information on holiday travel and under adverse weather condition would not be available from the core census; and

(ii) the AADT obtained would not be the 'genuine' AADT but rather one for normal days.

2.3.6 Surveys of the Coverage Stations in the Major Link Network

2.3.6.1 The functions of the coverage stations should be as follows:-

(i) provide link specific estimates of traffic counts at a large number of stations; and

(ii) provide a 'benchmark' function such as in the estimation of the annual vehicle kilometrage.

2.3.6.2 As in the case of core stations, the Surveys of coverage stations covers the whole Major Link Network. Conceptually, every link in the network is the sampling unit but in order to avoid having core and coverage stations at the same link, all links covered by the core stations and stations at screenlines/cordons can be excluded.

2.3.6.3 The primary consideration in the design of the coverage census is that traffic counts have to be obtained at every link, although not all in the same year, and that traffic counts obtained should, apart from giving estimates in absolute terms, provide a basis to monitor the traffic trend over time.

2.3.6.4 As resources available are in general limited, a rotating census in which a fraction of the links are covered in any one year has to be accepted. The census is repeated every year at completely or partially different sites and after a cycle of a few years, traffic counts are obtained at every link. For sites which are not covered in the current year, traffic flow can be estimated by multiplying the previous year's AADT by the factor reflecting the change of traffic between the two consecutive years.

2.3.6.5 The requirement of providing a basis to monitor the traffic trend over time favours a partially overlapping design such that traffic counts are repeated at a portion of the coverage stations conducted in the previous year. The overlapping design results in a greater gain of precision due to correlation of the overlapping portion, the gain increasing in proportion to the degree of overlapping. However, a greater degree of overlapping implies a larger sample size is needed every year if all the links are to be covered in a cycle of a fixed number of years.

2.3.6.6 For a fixed total number of links and leaving aside the precision requirements, the sample size of the coverage census in a year depends on the degree of overlapping of coverage stations between successive years and the cycle duration within which all the links are covered.

2.3.6.7 For instance, for a network consisting of 1400 links to be covered by coverage stations, some 560 links have to be covered each year if a Surveys design with 50 per cent overlapping between successive years over a cycle of 5 years is to be adopted. The design can be presented in a pictorial form as follows:-

Year	Sample Parts Selected
1	ab
2	bc
3	cd
4	de
5	ea

where: a,b,c,d,e, each represents 280 randomly selected locations in the network such that each link is included in one and only one of the five sample parts.

2.3.6.8 Depending on the emphasis of the objective, there are variants to the design proposed above. Thus, if the degree of overlapping can be relaxed to 25 per cent with a corresponding decrease in the level of precision in estimating changes, the duration of the cycle reduces to 3 years for the same number of coverage stations covered every year.

2.3.6.9 The procedure of selecting coverage station sites can be illustrated by means of an example for 5 sample parts to be covered over a cycle of 5 years with 50 per cent overlapping between successive years:-

(i) The links in the network or stratum are first listed in any convenient order.

(ii) Starting from each of the first 5 links in the list, every 5th links down the list are put together to form a sample part. Thus, a total of 5 sample parts a, b, c, d, e, each of which is a representative sample of the population, can be formed.

(iii) For the first year, two sample parts, say a and b, are selected randomly and observation of traffic flows are obtained at links in a and b.

(iv) One of the 2 selected sample parts, say b, is retained and together with a new sample part, say c, randomly selected from the remaining three sample parts form the sample for the second year.

(v) The above procedure for selecting sample parts is repeated for the third, the fourth and fifth years.

2.3.6.10 Short-period counts are to be recorded at all the links selected for that year. The duration of the short-period count can range from 4-hour to 48-hour, depending on the level of precision required. Consideration should also be given to time of the year that traffic counts at coverage I stations are to be recorded. It is best to avoid taking short-period counts on Public Holidays, days of adverse weather and horse-racing days.

2.3.6.11 Initially, a 24-hour count using non-recording counter may be appropriate taking into consideration the sample size of 560. The short-period counts should preferably be recorded during a normal weekday in order to obtain a more stable estimate of AADT. If traffic counts in the summer months are found to be unstable, then short-period counts should not be recorded at these times. Classified traffic counts should be recorded whenever possible.

2.3.7 Additional Counting Stations

2.3.7.1 The locations of core and coverage stations are selected through a random yet rigid approach. At times, additional traffic counts are required at some locations other than the core sites and coverage sites selected for the year. These locations may not be sampled through a random process but may be predetermined for ad hoc analysis. For instance, the sites comprising a cordon or a screenline are fixed to the extent that they are located at some strategic points in the network.

2.3.7.2 Apart from the selection process, the duration of traffic counts at these additional sites differ, depending on the level of precision required, the uses they are put to and their relative importance, in terms of traffic volume or other criteria. For example, depending on their traffic volumes, the duration of traffic counts at sites forming a cordon or a screenline may differ and range from a 24-hour count each year to a weekly count each month.

2.3.8 Additional Information

2.3.8.1 Traffic flow volume alone cannot satisfy the growing and complex demand of the users. Traffic data are not restricted to volumetric counts and include a great deal of other information such as speed for speed limit policy, accident and speed-flow analyses, vehicle mix and axle loads for road pavement design, trip origin/destination, trip purpose and vehicle occupancy for transport studies.

2.3.8.2 The recording and measurement of these information can be achieved by roadside interview and observation, or by the use of technical equipment. It may thus be necessary to set up a system at core sites and other additional locations whereby these data can be collected or recorded on a regular or ad hoc basis.

2.3.8.3 Presently, vehicle classification and occupancy counts on weekdays (Monday to Friday) are collected in all the core and coverage stations along the screenlines and cordons.

2.3.9 Minor Link Network

2.3.9.1 The traffic flow trends and variations obtained from the Major Link Network may be applicable to the Minor Link Network. However, when absolute level of travel such as vehicle-kilometrage is required, it may be necessary to conduct a separate study, though of a smaller scale, for the Minor Link Network such that the results from the Major and Minor Link Networks together may give a more complete result.

2.3.9.2 It is necessary to estimate separately the vehicle-kilometrage for the Minor Link Network which when added to that for the Major Link Network will produce the gross vehicle-kilometrage for the whole ATC network. A simplified approach to obtaining vehicle-kilometrage for the minor link can be described as follows:-

(i) assign the minor links to a number of strata based on say region, traffic volume, type and length of road;

(ii) select with probability proportional to length of road link some predetermined numbers of links for these strata and conduct a 24-hour traffic count at the links selected;

(iii) identify the traffic characteristics of the selected minor links and associate them individually with the groups established in Section 2.4.3;

(iv) convert the 24-hour traffic count to AADT - by applying the scaling factor derived for the associated group to the 24-hour traffic count;

(v) obtain the average AADT of all the links in each stratum;

(vi) multiply the average AADT of each stratum by the total length of roads in the respective strata;

(vii) sum the vehicle-kilometrage obtained for the strata to arrive at an estimate of the total vehicle-kilometrage for the Minor Link Network.

2.3.10 Updating of Traffic Counting Station Requirements for New Roads

2.3.10.1 In order to ensure that suitable location and space for traffic census equipment, as well as access for data collection, are provided for new roads, relevant departments/consultants that will be involved in the planning, design and construction of roads should consult the Traffic and Transport Surveys Division of Transport Department at an early stage such that any required traffic census provision is incorporated in the design.

2.3.10.2 An Automated Incident Detector with traffic counting function will be installed between the entrance to, and exit from, all roads in the future Strategic Road Network.

2.4 Equipment

2.4.1 General

2.4.1.1 The main items of equipment generally used in data collection for the traffic census system include:-

(i) Traffic Counters for counting the number of vehicles (or axles) passing over a selected section of the carriageway.

(ii) Vehicle Detectors for detecting the passage of vehicles over a selected section of the carriageway.

(iii) Roadside Cabinets for protecting the traffic counter from adverse environmental effects and against theft or vandalism.

(iv) Specially Equipped Vehicles for transporting counting equipment, roadside cabinet and personnel between counting sites and depots.

2.4.2 Traffic Counters

2.4.2.1 Two types of recording traffic counters are in use. They are:- (a) SarasotaVC1600 counters (b) Peek Advanced Data Recorder (ADR) counters.

2.4.2.2 The Sarasota VC1600 traffic counters and the Husky Hunters form respectively the road side unit (RSU) and data retriever of the Sarasota data collection equipment. The Husky Hunter is a CP/M compatible microcomputer which allows the operator to set-up the RSU, check the counting performance, collect and display data and erase or store memory. The installed software enables the interface with devices fitted with a RS232 port, such as printers or minicomputers. After retrieval of data from the RSU, the data hunter also allows subsequent formatting of data when connected to a terminal printer. Through the RS232 port, the data hunter can transfer its memory in bulk or by file names to another computer system for further processing. VC1600 is an 8-channel traffic volume analyser with the aim sensors and inductive loop detectors under the control of a microprocessor. Data are stored in the solid state memory with an identifying 'header' which contains the site number, date and time of set up and other setting up parameters. Each RSU accepts 2 pneumatic inputs and a maximum of 8 inductive loop detector inputs. It has a special feature that both the CPU and the SL29C inductive loop detectors are mounted on separate electronic modules which can be easily and quickly dismantled or reinstated simply by plugging in the module into the card frame of the RSU. This enables the operator to make easy access to the detectors on site for frequency settings to avoid crosstalk. Furthermore, this facility allows an economical use of the SL29C inductive loop detectors by fitting different numbers of detectors, varying from 0 to 8, at each RSU according to the site requirement. As the SL29C detectors are self tuning, the VC1600 counters operate satisfactorily with inductive loop installations. Where an air-tube is used, each pneumatic sensor can perform volumetric counts on roads with up to 4 traffic lanes. This type of counter is still widely employed on roads with 3 or more traffic lanes carrying heavy traffic flow.

2.4.2.3 The Peek Advanced Data Recorder (ADR) is one of the most advanced, yet simple to operate instruments for counting, and classification of traffic. It is completely self-contained, and includes all display and keypad facilities for configuring, data collection and live monitoring. Depending on array configuration, the ADR is able to record the total volume of traffic, and a vehicle’s direction, headway, gap, speed, axle classification, length and weight. In addition, details can be recorded on a per-vehicle basis for later analysis. The ADR has a communication port, which allows a PC installed with a tailor-made software – Vehicle Information Surveys Analysis (VISA) to modify the ADR’s settings and to collect the data stored. In fact, everything that can be done from the front panel of the ADR can also be achieved by controlling the ADR from a PC, which gives the possibility of using a low-cost ADR that

has no front panel. If required, the PC can communicate with the ADR via a modem by using an optional telemetry software package. A rechargeable battery is supplied with portable versions of the ADR, which typically gives up to 60 days of recorder operation between charges. ADR-2000 is an 8-channel traffic volume analyser with 4-tube inputs, plus 3 additional slots, each of which contain an 8-input piezo board, an 8-input loop board, an 14-input contact closure board, and an 8-input piezo WIM board.

2.4.3 Vehicle Detectors

2.4.3.1 A vehicle detector senses the passage or presence of a vehicle. The two types of vehicle detectors being used for in the traffic census system are the pneumatic tube detector and the inductive loop detector.

2.4.3.2 The pneumatic tube detector is a thick walled rubber tube stretched across the road, held in position by clamps nailed into the pavement. When a vehicle crosses the tube, a signal is sent to the data recorder by means of air movement. Pneumatic tubes are widely used because traffic counts are required for a short period of time at many counting stations. It is economical to install pneumatic tube detectors at these temporary sites.

2.4.3.3 The inductive loop operates by sensing the electrical properties of a coil of wire buried just below the road surface. When a vehicle passes over a magnetised loop, a change of inductance will be generated. Apart from volumetric counts, inductive loops can be used to measure other traffic data such as vehicle classification and speed, though the arrangement of the loops will be different. The use of inductive loops is recommended for core stations, heavily trafficked and high speed roads where the installation of pneumatic tubes is hazardous.

2.4.4 Roadside Cabinet

2.4.4.1 A cabinet is provided at the counting site to house the traffic counter, in order to protect it from theft and vandalism. It also provides some basic environmental protection e.g. against direct solar radiation, rain and physical damage in the event of traffic accident.

2.4.4.2 At sites where pneumatic tube detectors are used, security metal boxes are provided to reduce capital cost and allow for maximum flexibility. These cabinets are constructed in the form of a galvanised mild steel box with or without a detachable metal frame.

2.4.4.3 For sites equipped with inductive loop detectors, permanent roadside cabinets are installed, these are obsolete traffic light signal controller cases.

2.4.5 System Detector Station

It is a station on a core site where the inductive loop detector is connected to a roadside controller cabinet provided with datalink and power supply for data collection purpose. The Delta 3 Controller cabinet possesses traffic counting function and connects to the SCATS computer system located at a control centre at Tsuen Wan, Kowloon or Hong Kong. Data collected from the SCATS would then be retrieved via a remote workstation through telephone lines.

2.4.6 Integrated Area Traffic Control Station

The Area Traffic Control System has been employed, in addition to its signalised junction control function, to take traffic counts by integrating the inductive loop detector to appropriate Delta 4 Controller located at signalised junctions for a core site. The function of the controller needs to be expanded by modifying the EPROM to perform traffic counting. Similar to the Delta 3 Controller, it is connected to the SCATS and transfer data via a remote workstation.

2.4.7 Standalone Station

The standalone station records traffic count by connecting an inductive loop to a traffic counter placed in an adjacent roadside cabinet for a core site. Volumetric counts are automatically stored into the counter.

2.4.8 Specially Fitted Vehicles

2.4.8.1 Vehicles are required for the transport of counting equipment, roadside cabinets, tools, installation crew and data collectors. Some of these vehicles should be specially fitted for the transport of these roadside cabinets and have a sliding frame with a manual up-lifting winch.

2.4.8.2 Arrangements will also need to be made to hire crane lorries from private sectors for transporting both the existing concrete boxes and permanent roadside cabinets during the peak months or during the breakdown of the above specially equipped vehicles.

2.5 Installation and Removal of Equipment

2.5.1 General

2.5.1.1 The installation works associated with the traffic counting system include the preparation of installation schedules and the installation of the traffic counters, roadside cabinets, pneumatic tubes and inductive loops.

2.5.1.2 To avoid the need for arrangement of road/lane closure or newly constructed roads, particularly elevated road section and expressway, to install any required traffic census equipment, it is essential that such installation work be completed as part of the construction works prior to the opening of the new roads. In this respect, close liaison between relevant departments/consultants and the Traffic and Transport Surveys Division of Transport Department should be maintained.

2.5.2 Operational Schedule

2.5.2.1 A traffic counter is not installed permanently at counting site. It is only installed on the site at the time of data collection and is then moved to other site when this is completed. This arrangement allows a large number of counting sites be served by a relatively small number of counters.

2.5.2.2 Basically, the annual operation is divided according to the types of station which require different collection frequencies. For core stations and coverage stations on a particular screenline/cordon, the collection of traffic volume counts must be completed within a maximum period of a month -in order to ensure a continuous and consistent set of data.

2.5.2.3 In contrast, for coverage stations which are not associated with any screenline/ cordon, traffic volume counting are purposely scattered throughout the year to enable a random spread of measurements. This arrangement, however, may introduce some pressure on the transportation of counters and metal boxes. Data collection at coverage stations is generally carried out according to a district rotation system which poses the least demand for the transportation of equipment between sites.

2.5.2.4 The number of installation of traffic counting stations to be scheduled in each month varies widely, depending on a number of factors including the presence of public holidays, festivals and wet seasons.

2.5.2.5 For scheduling of equipment and staff, an annual installation schedule is prepared. However adjustments are often required to cater for interruptions caused by unexpected events such as inclement weather or equipment malfunctions.

2.5.2.6 For traffic flow measurement, the monthly installation schedule is arranged to avoid public holidays and festivals. For the collection of daily and hourly directional flows, each counting period usually lasts for 9 consecutive days covering two weekends. This gives additional safeguard against suspect or unacceptable data.

2.5.2.7 Data collection from the coverage stations which are not included in a screenline/cordon is generally carried out at the end of each month. Although one weekday flow is required, to ensure reliability of data, the minimum time for data collection is three days so that a continuous one-day flow is obtained. This data will be examined for fluctuations and consistency with past records.

2.5.3 Choice of Counting Site

(i) The road section should be straight to ensure good visibility for drivers. This will also help to ensure the safety of field staff during the installation of detectors.
(ii) Road surface should be smooth and stable, free from any cracks, subsidences or corrugations.
(iii) The road section should preferably be narrow.
(iv) The site should not be close to intersections, bus bays, traffic lights, pedestrian crossing and on-street parking.
(v) The road section should be where good lane discipline can be observed.
(vi) Adequate space should be available on the roadside to accommodate the roadside cabinet without causing any unnecessary inconvenience to the public.
(vii) The site should be free from the threat of flooding.
(viii) The site should have sufficient space for the parking of the service vehicle.
(ix) For short duration installation jobs on high speed roads, police escort should be secured as a precautionary measure. Data collection at such spots should better be done by loops installed under the road surface.

2.5.4 Placing of Roadside Cabinet

2.5.4.1 The traffic counters are housed in roadside cabinets for security and protection purposes. Such roadside housing is normally placed on the footpath or central median with a clearance of about 0.6 m from road kerb. All road-side housings should be locked by galvanised pad locks accessible by a common key.

2.5.4.2 The roadside cabinet should be kept in good condition and should be made compatible with the surrounding environment as far as possible.

2.5.5 Installation of Pneumatic Tube Detector

2.5.5.1 Proper installation of the pneumatic tube detector is essential because it will affect the quality of data and the life of the tube.

2.5.5.2 The tube is laid transversely across the road and is held in position by canvas cleats nailed onto the carriageway at approximately 0.9 m apart. The tube end is plugged with a 5/16" Dia x 1" brass machine screw. This tube terminal is raised and fixed by an end clamp on top of kerb to prevent damage and ingress of water.

2.5.5.3 As the installation crew is required to work on the carriageway, safety becomes a very important aspect. Assistance and advice from the Police, Highways Department and project contractors should be considered. Staff should make reference to the 'Code of Practice for the Lighting, Signing & Guarding of Road Works',. Vehicles used should also be examined to see whether they are properly marked for their specific purposes. Installation of the tube should be carried out on a lane-by-lane basis to minimise disruption to traffic.

2.5.6 Installation of Inductive Loop

2.5.6.1 The recommended practice of inductive loop installation is described in TTSD Technical Note 7/84 "Inductive Loops -Installation Practice".

2.5.6.2 The inductive loop and its feeder are made of a continuous hypalon wire placed in a pre-installed slot on the road surface and embedded in epoxy resin and topped by bitumen buried just beneath the road surface. Normally each loop contains 3 plys of wire.

2.5.6.3 Prior to loop installation, layout drawings indicating the location, configurations, and dimensions of the loops and the roadside cabinet should be prepared. The method and staging of construction should be proposed, including any necessary temporary traffic diversion measures. Various parties affected (such as the police, Highways Department and Transport Department, etc.) should be consulted in advance.

2.5.6.4 The engineering works required for the installation of inductive loops comprise essentially the following:-

(i) Cutting slot on road surface

(ii) Laying wire

(iii) Covering wire with epoxy resin

(iv) Backfilling slot with hot oxidised bitumen

(v) Connecting the loop termini with the roadside cabinet

(vi) Erecting the roadside cabinet

(vii) Reinstating road surface and footpath

(viii) Commissioning the inductive loops

2.5.7 Installation of Counter

2.5.7.1 During the installation of the traffic counter, the following procedures should be followed:-

(i) Check that the right type of counter is used.

(ii) Check the battery connections and battery conditions.

(iii) Ensure that every entry e.g. site no., date, time, recording period and counting configuration is correct.

(iv) Ensure that the traffic counter is properly connected to detector.

2.5.7.2 After setting up the counter and detector(s), the counting accuracy of the station must be checked carefully. Data collection should only begin if the result of this check is satisfactory. This involves the following procedures:-

(i) Carry out manual count for 15 minutes or until 100 vehicles have passed over the detector. Record the counter reading at the same time.

(ii) Compare the manual count and the recorded counter reading.

(iii) If necessary, re-adjust the counter or check the tube/loop detector.

2.5.7.3 The counter accuracy check should be repeated at least on a weekly basis as part of the routine counter servicing for stations where a prolonged period of traffic count is needed. At the end of the data collection period and prior to the removal of the counter, a counter accuracy check is again carried out. Data collection is regarded as complete only if the result of the accuracy check is satisfactory.

2.5.8 Removal of Equipment

2.5.8.1 When data are collected and are found satisfactory, the counter and the security metal box should be removed for use at other counting site according to the monthly installation schedule.

2.5.8.2 At the core stations and coverage (B) stations, only the tube is removed leaving the canvas cleats on site for installation in the following month. For coverage (C) stations, the tube and canvas cleats are completely removed.

2.5.8.3 For sites with inductive loop detectors, the counter is removed but the inter-connection cable, i.e. the socket and cable assembly connecting the loop termini to the traffic counter, is permanently left in the roadside cabinet.

2.6 Data Collection

2.6.1 General

2.6.1.1 Traffic counters are installed according to the annual and monthly installation schedule to collect and record traffic flow data. The duration of measurement and the type of traffic data collected depends on the requirement of each type of station.

2.6.2 Classification of Counting Station and Equipment Requirements

2.6.2.1 There are three types of counting stations in the existing counting system, viz. core (A) stations, coverage (B) stations and coverage (C) stations.

2.6.2.2 The requirements of data to be obtained from each type of station and the equipment required to achieve this are summarised in Table 2.6.2.1.

2.6.2.3 Self-recording counters are widely used for all the different types of stations. They are also used to measure traffic flow at coverage stations installed at remote locations as it would be impractical to send data collectors to visit these locations for counter reading on a daily basis. For this reason, self-recording traffic counters are used

2.6.2.4 Real-time volumetric count at core stations can be obtained by integrating the detector system into either a nearby Area Traffic Controller (Delta 4 Controller) or a special designed Delta 3 Controller where a Delta 4 Controller is not available.

TABLE 2.6.2.1 Data and Equipment Requirements

Type of Station	Type of Counter Used	Minimum Duration of Measurement	Data Required
Core (A) Station	Recording (computer compatible type preferable)*	1 week in each month	Daily and hourly directional flows
Coverage (B) Station	Recording (computer compatible type preferable)*	One week	Daily and hourly directional flows
Coverage (C) Station	Recording (computer compatible type preferable)*	One weekday (Monday to Friday)	Daily non-directional flows

2.6.3 Counter Reading

2.6.3.1 The date of installing traffic counters is recorded on the servicing sheets. Data retrieval from the recording counters are normally carried out according to the servicing sheets and would generally tie in with the counter maintenance as far as practicable. The data should be collected within office hours by staff visiting the counting sites where traffic counters are installed.

2.6.3.2 Where a System Detector Station or an Integrated Area Traffic Control Station is employed, volumetric counts are instantly available through a workstation connected to the SCATS.

2.6.4 Routine Maintenance

2.6.4.1 During the course of counter reading or counter servicing, the following maintenance measures should be taken:-

(i) Remove any object collected near the tube e.g. debris, loose coarse aggregates, waste cotton rolled around the tube etc. These may lead to inaccuracy of counts or even damage to the tube.

(ii) Check the condition of canvas cleats, fixing clamps etc., and replace the damaged cleats.

(iii) Pump air into the tube to detect any leakage due to puncture or blockage and to blowout dirts or particles, if any, collected inside the tube.

(iv) If a tube is found to be loosened, re-tension the tube by a 5% reduction in natural length of the tube.

(v) Check the traffic counter for correctness of time and data information.

(vi) Inspect for any loss of data due to malfunctioning of printer, or 'reset to zero' mechanism.

(vii) Check the battery level and change battery as required.

(viii) Check and ensure that crosstalk does not occur if inactive loop detectors are used.

(ix) Carry out counter accuracy check as described in 2.5.7.2.

2.6.5 Data Recording

2.6.5.1 Traffic data are either collected by means of a data hunter or a portable computer. Adjustments necessary to correct for counter reading time, over/under counting, etc., are made at this stage. Any irregularity observed will also be recorded for future reference.

2.6.5.2 Traffic flows retrieved by the data hunter or a portable computer are immediately formatted by hour, date and day in a printer to produce daily flows. Data retrieved from core stations are dumped into a microcomputer for data sorting and analysis.

2.6.5.3 Traffic flows recorded by a Delta 3 or Delta 4 Controller are stored in the main frame computer for the SCAT System in which real time data can be extracted from a peripheral computer. Similarly, the data are immediately formatted by hour, day of the week and date to produce daily flows which will then be sorted and analysed for incorporation into reports.

2.6.6 Vehicle Classification and Occupancy

Apart from traffic flow, the type of vehicles and their passenger occupancy in the flow are also recorded. These Surveyss are only conducted for core and coverage stations on cordons and screenlines. Vehicles are classified into eight types and Surveysed from 0700 – 2300 hours. Only for franchised buses, the Surveys is conducted for the entire hour in the 16-hour period. For other types of vehicle, i.e. motorcycles, private cars, taxis, passenger vans, public light buses and goods vehicles (light goods vehicles and heavy goods vehicles), the Surveys is conducted for only 15 minutes in each hour.

2.7 Data Analysis

2.7.1 General

2.7.1.1 The generalization of characteristics for each group based on traffic counts at core (A) stations would facilitate the estimates for coverage sites. Apart from the estimation of AADT and the pattern of traffic at different times of the day and year, growth factors of AADT between successive years can be derived.

2.7.1.2 The estimates obtained are subject to both sampling and non-sampling errors. The sources of error can be summarized as follows:-

(i) Non-sampling error
- machine reliability/mechanical error;
- conversion of number of pairs of axles to number of vehicles;
- mis-classification/mis-count of vehicles;

(ii) Sampling error

2.7.2 Core (A) Station

2.7.2.1 For the Dth day of the week, the average daily flow $K^{ADT}D$ at site K for the year can be estimated by:-

$$K^{ADT}D = (1/m)\sum_{M=1}^{m} K^{DT}D,M$$

where D = Sunday, Monday,... Saturday (Sunday includes Public Holiday)

M = January, February,..., December

$K^{DT}D,M$ = Observed daily flow at site K for the Dth day of the week in the Mth month

m = number of weeks data are recorded.

2.7.2.2 AADT

(i) $$K^{AADT}(All-day) = (1/n)\sum_{D} n_D K^{ADT}D$$

where n_D = No. of Dth (Sunday, Monday,..., Saturday) days in the year. It should be noted that Sunday includes Public Holiday

n = Total number of Dth day in the year

(ii) $$K^{AADT}(Mon.-Fri.) = (1/N_r)\sum_{V} n_V \bullet K^{ADT}V$$

where V = Monday,..., Friday

Nv = Total number of Monday,...,Friday in the year excluding Public Holidays

n_v = Total number of the Vth day in the year, excluding Public Holidays

(iii) $$K^{AADT}(Sat.) = K^{ADT}S = (1/m)\sum_{M=1}^{m} K^{DT}S,M$$

where S = Saturday

(iv) $$K^{AADT}(Sun.) = K^{ADT}U = (1/m)\sum_{M=1}^{m} K^{DT}U,M$$

where U = Sunday

2.7.2.3 Monthly Variation

(i) All-day (Mon. - Sun.)

Overall daily average ${}_1A = (1/1^n)\sum_M\sum_D K^{DT}D,M$

Where D = Sunday, Monday, …, Saturday

1^n = Total number of Sunday, Monday, …, Saturday selected = 84

Daily average for Mth Month ${}_1B_M = (1/1^nM)\sum_D K^{DT}D,M$

where 1^nM = Total number of Sunday, Monday, …, Saturday selected in the Mth Month = 7

Monthly variation factor $= (1^BM/1^A)*100\%$

where M = January, February, …, December

(ii) Monday- Friday

Overall daily average ${}_2A = (1/2^n)\sum_M\sum_V K^{DT}V,M$

where V = Monday,…,Friday

2^n = Total number of Monday, …, Friday selected = 60

Daily average for Mth month ${}_2B_M = (1/2^nM)\sum_V K^{DT}V,M$

where V = Monday, …, Friday

2^nM = Total number of Monday, …, Friday selected in the Mth month = 5

Monthly variation factor $= (2^BM/2^A)*100\%$

where M = January, February, …,December

(iii) Saturday

Monthly variation factor $= (K^{DT}S,M/K^{ADT}S)*100\%$

where M = January, February, …, December

S = Saturday

2.7.2.4 Daily Variation

Daily variation factor for the Dth day $= (K^{ADT}D/l^A)*100\%$

Where D = Sunday, Monday, …, Saturday

2.7.2.5 Hourly Variation

(i) All-day {Mon. - Sun.}

Hourly variation factor for the Hth Hour $= (\sum_M\sum_D K^{DT}H,D,M/\sum_M\sum_D K^{DT}D,M)*100\%$

where D = Sunday, Monday, …, Saturday

(ii) Monday- Friday

Hourly variation factor for the Hth hour $= (\sum_M\sum_V K^{DT}H,V,M/\sum_M\sum_V K^{DT}V,M)*100\%$

where V = Monday, …, Friday

(iii) Saturday

Hourly variation factor for the Hth hour $= (\sum_M K^{DT}H,S,M/\sum_M K^{DT}S,M)*100\%$

where S = Saturday

(iv) Sunday

Hourly variation factor for the Hth hour $= (\sum_M\sum_D K^{DT}H,U,M/\sum_M\sum_D K^{DT}D,M)*100\%$

where U = Sunday

2.7.2.6 R 12/24

(i) All-day (Mon-Sun.)

$$R_{12} = (\sum_{M}\sum_{D}\sum_{H=7}^{18} K^{DT}H, D, M) / (\sum_{M}\sum_{D} K^{DT}D, M)$$

where D = Sunday, Monday, …, Saturday

(ii) Monday- Friday

$$R_{12} = \sum_{M}\sum_{V}\sum_{H=7}^{18} K^{DT}H, V, M / \sum_{M}\sum_{V} K^{DT}V, M$$

where V = Monday, …, Friday

(iii) Saturday

$$R_{12} = \sum_{M}\sum_{H=7}^{18} K^{DT}H, S, M / \sum_{M} K^{DT}S, M$$

where S = Saturday

(iv) Sunday

$$R_{12} = \sum_{M}\sum_{H=7}^{18} K^{DT}H, U, M / \sum_{M} K^{DT}U, M$$

where U = Sunday

2.7.2.7 R 16/24

The corresponding formulae for 2.7.2.6 are used but H assumes the values from 7 to 22 inclusive.

2.7.2.8 Peak Hour (Monday -Friday)

(i) Starts at
From the Hourly Variation for Monday Friday, search for the hour with the highest percentage of traffic*(K%)*.

(ii) Two-Way Flow
Multiply K% by AADT (Monday -Friday)

(iii) K
From the Hourly Variation for Monday-Friday, search for the highest hourly percentage *K%.*

(iv) D (Directional Flow)
For stations with two directions of flow, calculate

$$Z = (\sum_{M}\sum_{V} K^{DT}M, V, H / \sum_{M}\sum_{V} K^{DT}M, V, H) * 100\%$$

where M = January, February, …, December
V = Monday, …, Friday
H = Peak hour
DT' = denotes traffic flows in one direction
then
D = z if $z \geq 50\%$
= 100-z if $z < 50\%$

2.7.2.9 D 24

The corresponding formula for 2.7.2.8 (iv) is used but H assumes the values from 00 to 23.

2.7.2.10 Peak Hour (Sunday)

Repeat section 2.7.2.8 using traffic flows for Sunday only.

2.7.2.11 Ratio of AADT to Daily Flow

For grouping of sites, calculate the ratios of AADT to daily flow as

$K^{AADT} / K^{DT} D, M$ for all K,D,M

2.7.3 Cordon/Screenline

2.7.3.1 Comprising a number of traffic counting stations, cordons/screenlines are formed in different parts of the territory. Results similar to those for core (A) stations are required at these cordons/ screenlines. These estimates are derived in similar ways as those for core (A) stations, using traffic data at all individual stations forming the cordon/screenline. Additional information on passenger volumes can also be obtained at cordons/screenlines by recording the relevant occupancies of different types of vehicles.

2.7.4 Annual Average Daily Traffic of Coverage Stations from 24-Hour Count

2.7.4.1 Scaling factors $E_{D,M}$ pertaining to the Dth day in the Mth month for converting 24-hour counts to AADT are obtained for each group. For coverage stations belonging to the same group, their annual average daily traffic C^{AADT} can be estimated from a 24-hour count $C^{DT}D,M$ observed on the Dth day in the Mth month by

$$C^{AADT} = E_{D,M} \cdot C^{DT} D, M$$

2.7.5 Annual Average Daily Traffic of Coverage Stations not covered in current year

2.7.5.1 For coverage stations not covered in the current year T, the annual average daily traffic $C^{AADT}T$ for the year T can be estimated by applying the appropriate growth factor to the annual average daily traffic $C^{AADT}T\text{-}1$ of the previous year T-1.

2.7.5.2 The growth factor between 2 consecutive years can be obtained for different groups/strata. Using data from core stations only, the growth factor for a group/stratum can be obtained as

$$G_1 = [\sum_K (K^{AADT}T / K^1) / \sum_K (1/K^1)] / [\sum_K (K^{AADT}T - 1/K^1) / \sum_K (1/K^1)]$$
$$= \sum_K (K^{AADT}T / K^1) / \sum (K^{AADT}T - 1/K^1)$$

where K denotes core stations in the group/stratum
K^1 denotes length of the road link of Kth core (A) station

2.7.5.3 However, if data from coverage stations only are used, the growth factor for a group/stratum can be estimated as

$$G_2 = \sum_C C^{AADT}T / \sum_C C^{AADT}T - 1$$

where C denotes coverage stations in the stratum
G1 and G2 are separate estimates of the growth factor for the same group/stratum. A composite estimate G of the growth factor is to be preferred:-

$$G = z_a \bullet G_1 + z_b \bullet G_2$$

where z_a, z_b are constants to be determined to maximize the precision of the growth factor subject to $z_a + z_b = 1$

2.7.5.4 Having determined the growth factor G, the estimate of the current years $C^{AADT}T$ of the coverage station in the same group/stratum can be obtained as

$$C^{AADT}T = G \cdot C^{AADT}T - 1$$

2.7.6 Vehicle Kilometrage

2.7.6.1 The annual gross travel in vehicle-kilometres can be obtained for the Major Link Network, and the Minor Link Network and hence for the road network as a whole.

2.7.6.2 Vehicle kilometrage is calculated for each road type as the product of the weighted average of A.A.D.T.s and the road length. The summation for all road types provides an estimate of the gross amount of travel. The calculation of vehicle kilometrage for major and minor road networks is presented as follows:-

(a) Major Road Network

The vehicle-kilometres (VK) for each region (r) for each type of major road (t) is calculated by the following formulas:

$$VK_{r,t} = VK_{r,t}(core) + VK_{r,t}(\text{cov}\,erage)$$

$$VK_{r,t} = \sum_{i=1}^{N_{core}} l_{i,core,r,t} \times AADT_{i,core,r,t} + L_{coverage,r,t} \times \overline{AADT}_{coverage,r,t}$$

where

$l_{i,core,r,t}$ = Length of major road link under core station i for road type t in region r

$AADT_{i,core,r,t}$ = AADT for core station i for road type t in region r

$L_{coverage,r,t}$ = Length of major road links under all coverage stations for road type t in region r

$\overline{AADT}_{coverage,r,t}$ = Weighted mean AADT for sampled coverage stations for road type t in region r

(b) Minor Road Network

The vehicle-kilometres (VK) for each region (r) for each type of minor road (t) is calculated by the formula:

$$VK_{r,t} = L_{r,t} \times \overline{AADT}_{r,t}$$

where

$L_{r,t}$ = Length of minor road links for road type t in region r

$\overline{AADT}_{r,t}$ = Weighted mean AADT for sampled minor road stations for road type t in region r

2.7.6.3 The annual vehicle-kilometrage of the whole road network VK is obtained by direct summation of results derived from the Major and Minor Road Networks:-

$VK = VK_1 + VK_2$

2.7.7 Vehicle Classification and Occupancy

Except for franchised buses, the raw data for all other types of vehicles are multiplied by four to obtain the hourly figures. By simple addition and proportioning, the percentage of each type of vehicle in the traffic flow and its average passenger occupancy are calculated.

2.8 Result Presentation

2.8.1 General

2.8.1.1 Results obtained from the Annual Traffic Census are generally presented in the form of an annual report.

2.8.1.2 Apart from showing the traffic counts and variations at each core and coverage stations, estimates pertaining to an aggregate level are also produced.

2.8.1.3 For ease of interpretation, consideration should also be given to presenting results in graphical formats.

2.8.2 Individual Station Level

2.8.2.1 For coverage stations based on scaling factors obtained from the core stations, a 24-hour (or other short-period) traffic count at the coverage station can be converted to the annual average daily traffic (AADT) .In the course of and at the end of a Surveys cycle, traffic data for each link of the Major Link Network can be made available. Specifically, consideration should be given to recording for each link the following road characteristics and traffic data:-

(1) link/station number

(2) location

(3) length and width

(4) direction

(5) type of carriageway

(6) number of lanes

(7) speed limit

(8) presence of lighting

(9) group type

(10) link capacity

(11) type of road

(12) day and date of traffic count

(13) duration of traffic count

(14) observed traffic count

(15) AADT

(16) peak hour
and if the classified hourly traffic counts are available,

(17) proportion of the daily traffic in the peak hour

(18) proportion of commercial vehicles during the traffic count period

(19) proportion of commercial vehicles in the peak hour flow i.e. T-factor

2.8.2.2 For core (A), coverage (B) and coverage (C) stations, at an individual site level, the kind of information available at stations should, apart from the road characteristics, include the following:-

(1) monthly variation of traffic flow

(2) daily variation of traffic flow

(3) hourly variation of traffic flow

(4) annual growth of traffic flow

(5) AADT (Monday -Friday)

(6) AADT (Saturday)

(7) AADT (Sunday)

(8) AADT (all-day)

(9) peak hour flow (Monday -Friday)

(10) peak hour flow (Sunday)

(11) K-factor

(12) D-factor

(13) T-factor

(14) vehicle classification and occupancy (peak hour)

(15) vehicle classification and occupancy (off-peak hour)

(16) vehicle classification and occupancy (16- hour)

2.8.3 Aggregate Level

2.8.3.1 Various sets of scaling factors for converting short-period traffic counts to that of a different time frame can be obtained. Specifically, scaling factors by day of the week and month for converting a 24-hour count to AADT can be produced.

2.8.3.2 Gross travel in vehicle-kilometre by type of vehicle and/or class of road are needed by, among others, users engaged in accident and road maintenance analysis. Using the results obtained at the various sites, vehicle-kilometrage by type of vehicle and/or class of road can be tabulated in a timely manner. At the end of the year when traffic flow data at coverage stations as well as those for the minor link network are available, annual vehicle-kilometrage can be produced and adopted.

2.8.3.3 Data similar to those specified for individual station in the Section 2.8.2 can be made available at a screenline or cordon. In addition, by applying the vehicle occupancies to vehicle counts, person trips can be produced. If additional Surveyss are conducted, the person trips can be tabulated by trip purpose and mode of transport. Such pieces of information are useful for calibrating transport models.

2.8.4 Classification of Vehicles

2.8.4.1 Classified counts by type of vehicle are required for road design and maintenance. Obviously, in respect of the design and maintenance standards, the effect of a heavy goods vehicle is greater than that of a private car or taxi. The UK Transport and Road Research Laboratory (TRRL) has developed a system that can classify vehicles into 25 types, the majority of which are goods vehicles distinguished by rigid/articulated and the number of axles. In view of the fact that only manual classified counts are recorded in the Territory, goods vehicles are classified as light and heavy at present.

2.8.4.2 Until the acquisition of sophisticated equipment is made, the classification of vehicles by type is confined to those that can be easily distinguished by visual inspection. Despite the limitation imposed by the manual procedure, it is thought that heavy goods vehicles can be further classified as rigid and articulated. By incorporating the distinction between rigid and articulated heavy goods vehicles into the existing vehicle classification system, vehicles may be classified as follows:-

(i) motor cycle;

(ii) private car;

(iii) taxi;

(iv) passenger van;

(v) public light bus;

(vi) light goods vehicle;

(vii) heavy goods vehicle -rigid;

(viii) heavy goods vehicle -articulated;

(ix) coach;

(x) bus- single-decked;

(xi) bus- double-decked;

(xii) tram; and

(xiiI) others.

Appendix I

Organisation of the Annual Traffic Census System

1 General

1.1 Routine Surveyss of traffic flow commenced in 1965. Changes in the operation procedures and organisation of the Surveys were effected from time to time, and after a major review conducted in 1971, the existing Annual Traffic Census was firmly established as an annual exercise.

2 Coverage

2.1 Because of limited resources, it is virtually impossible to cover the whole road network in any traffic Surveys. Those restricted roads and roads with low volume traffic in the rural areas are therefore excluded. In general, the existing Annual Traffic Census covers around 86% of the road network system of the Territory.

3 Road Classification System

3.1 Prior to 1985, roads have been classified in accordance with the hierarchy adopted in the Hong Kong Comprehensive Transport Study amended to include roads in the New Territories.

3.2 In line with the classifications recommended in Volume 2 of the Transport Planning & Design Manual, the road types adopted in the Annual Traffic Census are now classified as follows:-

Urban Road

(i) Trunk Road

(ii) Primary Distributor

(iii) District Distributor

(iv) Local Distributor

Rural Road

(v) Trunk Road

(vi) Rural Road (A)

(vii) Rural Road (B)

(viii) Feeder Road

4 Classification of Counting Stations

4.1 Depending on the ways collected traffic flow data are put to use, counting stations are classified as follows:-

(i) core (A) station

(ii) coverage (B) station

(iii) coverage (C) station

4.2 A full set of detailed traffic flow data is collected at each core (A) station, thereby monthly, daily and hourly variations can be made available.

4.3 At the coverage (B) station, traffic flow data collected are not as comprehensive as those for core (A) stations, as a result of which only daily and hourly variations can be obtained.

4.4 As for the coverage (C) station, a 24-hour traffic count is recorded in a single weekday annually.

5 Grouping of Road Links

5.1 It is obvious that a full set of detailed traffic flow data giving monthly, daily, hourly variations cannot be obtained at every selected station. The problem can be overcome by the linkage of stations. For instance, a set of coverage (B) stations having similar traffic characteristics is linked to core (A) stations of the same group such that the monthly variation of the coverage (B) stations are taken to be the same as that for the core (A) stations. The daily and hourly variations of a coverage (C) station are assumed to be those of an appropriately linked core (A) station. Details of the grouping of counting stations are described in the latest edition of “The Annual Traffic Census”.

5.2 In linking stations, knowledge of local conditions as well as other relevant factors have to be taken into consideration. Specifically, some stations are linked with reference to the land use which can be broadly classified as follows:-

(i) Bank, Hotel, Shops (Luxury) , Tourist Favourite Spots

(ii) Mixed Commercial

(iii) Mixed Residential

(iv) Mixed Industrial

(v) Industrial

(vi) Schools and Hospitals

(vii) High Rise Development

(viii) Low Cost Housing

(ix) Airport Area

(x) Low Density -Open Spaces, Military Area and Terrain Difficult for Development

TPDM Volume 8 Chapter 3 – Spot Speed & Journey Time Surveys

3.1 References

(1) Transport Planning & Design Manual, Volume 6 - Traffic and Environment Management

(2) The Annual Traffic Census 2000 - Traffic and Transport Survey Division, Transport Department

(3) U.K. Department of Transport, Departmental Advice Note TA 22/81, Vehicle Speed measurement on All Purpose Roads (1981)

(4) Car Journey Time Survey for Monitoring Traffic Congestion 2000 - Traffic and Transport Survey Division, Transport Department

(5) Video based solutions for data collection and incident detection - Traffic Technology International 96.

3.2 Introduction

3.2.1 General

3.2.1.1 Knowledge of vehicle speeds in a traffic system is important for traffic engineers and transport planners, for it provides useful information about travel conditions and levels of service. Speed is an important road design parameter, in an overall sense for setting design standards, and in an elemental sense as a measure of the effects of minor changes to a traffic system.

3.2.1.2 Broadly speaking, there are two classifications of speed namely:-

(a) spot speed (or time speed) and

(b) journey speed (or space speed)

Spot speed is the instantaneous speed of a vehicle at a specified point along a road while journey speed is the effective speed including any stopped times of the vehicle on a trip between two points.

3.2.1.3 Spot speeds are measured using devices such as radar speed meters or inductive loops. Journey speeds are derived from journey times (journey speed is the inverse of journey time per unit distance) which can be measured by moving observer methods or by recording and matching registration numbers and times of passing. Hence, the collection of data of vehicle speeds falls broadly into two types of surveys, viz. spot speed survey and journey time survey. This chapter discusses the measurement, data analysis and uses of the data obtained from these two types of surveys.

3.3 Spot Speed Survey

3.3.1 Uses of Spot Speed Data

3.3.1.1 Spot speed data are useful in the study of a number of aspects of driver behaviour.

3.3.1.2 One application in the use of spot speeds is "Before and After" speed studies, which help in assessing drivers' responses to new warning signs, road markings, street lighting and pavement surfaces.

3.3.1.3 Spot speeds are also important in assessing the need for appropriate speed limits or traffic control devices.

3.3.1.4 Spot speed studies may also have applications in the assessment of improvements of road alignments at bends, vertical curves, and short diversions, and in the design of zebra crossing and traffic signal installation.

3.3.2 Data Collection Methods

3.3.2.1 Measurement of spot speeds are generally made from a fixed location on the road. Four basic approaches may be used to collect speed data:-

i) measuring the travel time of a vehicle between two detectors separated by a known, fixed distance;

ii) measuring the time taken by a vehicle to cross an induction loop;

iii) measuring speed directly by a radar speed meter;

iv) measuring speed directly by a video image processing system; and

v) measuring speed directly by real-time tracking of vehicle.

3.3.2.2 Approaches (i) and (ii) in paragraph 3.3.2.1, are similar, indirect methods involving the estimation of speed from a travel time observation, whilst (iii), (iv) & (v) are direct methods for recording speeds. They will be described in more details in the following paragraphs.

3.3.3 Indirect Speed Measurement Methods

3.3.3.1 There are basically two methods of indirect speed measurement, and these are:-

i) Vehicle detector/timer method; and

ii) Video-recording method.

3.3.3.2 In respect of the vehicle detector/timer method this is an entirely automatic operation, providing mean speeds, frequency distributions, and other traffic data. However the method cannot distinguish cars from other vehicles, although vehicle separation by length is possible.

3.3.3.3 To measure the speed of vehicle with the vehicle detector/timer method, pairs of inductive loops or noisy cables are stuck to, or installed in, the road surface and connected to a detector/timer/counter unit which is securely fastened to some convenient roadside furniture. The passage of a vehicle over a loop/cable generates an electrical signal. The time interval between the start of the signal from the first loop/cable and the start of the signal from the second loop/cable is measured and, using the separation distance of the loop/cables, converted into a speed, which is recorded.

3.3.3.4 The video-recording method is a time-lapse photography method using video-cassette recording systems. It involves recording the distance moved by a vehicle in a selected short period of time, perhaps a couple of frames, and from this vehicle speed can then be computed.

3.3.3.5 The video-recording method has the advantage of providing a complete, permanent record of the traffic flow which can always be re-analysed and re-examined at a later stage. The disadvantage is that a considerable period of time is needed after the survey, to extract the data from the video record. Another drawback of this method is that under local conditions it is often difficult to select a suitable location to mount a video camera which can both command a good view of the road, but not be too conspicuous to the motorists.

3.3.4 Direct Speed Measurement Methods

There are basically two main methods of direct speed measurement namely:-

i) Radar Speedmeter.

ii) Video image processing system.

iii) Real-time tracking of vehicle

3.3.4.1 A radar speedmeter is the most commonly used equipment for measuring spot speed. It operates by transmitting a continuous beam of high frequency microwaves towards a vehicle and measuring the change in frequency between the reflected waves and the transmitted waves. The change in frequency, known as the Doppler effect, is directly proportional to the speed of the target vehicle relative to the speed of the radar meter. Thus a direct measure of speed is obtained.

3.3.4.2 There are a number of different types of speedmeters, including the large freestanding type and the hand-held type such as a radargun. Each type has its own special features to suit the purpose of the user.

3.3.4.3 When setting up and using a radar speedmeter account should be given to the following:

(i) When using the large freestanding type of a radar speedmeter the first requirement is that a chosen site should have sufficient space to accommodate the meter and the observers, without disturbing the traffic. A footbridge spans across the carriageway is the most ideal place for measuring spot speeds. A verge, an unused entrance, or the beginning of a layby, are also suitable.

(ii) The site should not be near junctions, unless readings are being taken in connection with improvements to the junction, or bus stops. Situations where the radar beam may be obstructed by parked cars, or where vehicles are likely to be accelerating or braking, should also be avoided.

(iii) The operating instructions for the meter should be carefully followed, especially in relation to interference and calibration. Some meters can be adjusted to ignore vehicles travelling in the “wrong” direction. With most meters, however, the response to those vehicles should be minimised by careful aiming of the antenna or by reducing the range setting.

(iv) It is best to have two observers, one reading the meter and the other recording the values. Using this method measurements can be confined to cars only if required. Provided that the traffic flow is light enough, and the observers have had enough practice, the speed readings for all vehicles under consideration (in one direction) should be recorded if possible. If the flow is too heavy for all such vehicles to be measured some sort of sampling procedure is needed. To avoid bias, the sampling must be based on an attribute that is not related to speed, and is easily decided, e.g. the registration numbers of vehicle (where odd or even number will give a 50% sample, and specified first or last digits will give 10%, 20%, etc.)

(v) A value should be recorded for every vehicle that satisfies the sampling criterion. Ideally, that value would be a steady reading on the meter, but except at very low flows, it will not be possible to get a steady reading for every vehicle that passes. Sometimes the meter will

give a brief indication - a flick of the needle, or a flicker of the digits - that can be recognized and accepted as the speed of the vehicle in question. Sometimes there will be no response at all. There are two different situations where readings are likely to be missed completely:-

(a) where a vehicle is overtaking another vehicle while both are in the radar beam.

(b) where a vehicle is following closely behind other vehicles, and the observer cannot be sure that the meter gave a separate reading for each.

If the missed readings are simply ignored, or recorded as a vehicle passing but with no speed registered and then omitted from the analysis, it is equivalent to assuming that the true speeds of these vehicles have the same distribution as those that were measured, and with the same mean. But if these missed speeds are likely to form a significant proportion of the total (say, more than 10%) some alternative assumptions are preferable. There are :-

(c) that vehicles travelling in a fairly compact bunch all have the same speed; and

(d) that overtaking vehicles are travelling (say) 15 km/h faster than the overtaken vehicle. Since the overtaken vehicle will often be a large vehicle, and since it is in any case closer to the meter, it will probably give a reliable reading.

Values arrived at in this way should carry a distinguishing mark in the records.

3.3.4.4 Video image processing is a new technology for traffic and incident detection. By mounting a camera to a light pole or an overhang structure such as a footbridge and linking to a computer-aided processing unit, information on traffic volume as well as vehicle speeds at a particular location can be obtained. However, it is not known whether this equipment can apply well to all weather conditions

3.3.4.5 Real-time tracking of vehicle
The vehicle under surveillance is fitted with a device for receiving Global Positioning System (GPS) signal and dead reckoning system to provide accurate real-time location of the vehicle. Signals on the location of the vehicle will be transmitted to a remote computer unit via radio communication at a regular time interval, say every other second, the position of the vehicle is thus tracked real-time on a Geographic Information System (GIS) map installed on the computer unit. Data on location, time, as well as speed of the vehicle can then be provided using the system.

3.3.5 Data Analysis

3.3.5.1 In the analysis of speed distribution, the 85 percentile speed is of particular significance. It is the speed only exceeded by 15% of the vehicles. For determining speed limit and for the design of traffic scheme, the 85 percentile speed is used as a yardstick.

3.3.5.2 There are several ways of estimating the 85 percentile speed from sets of measurements. The most direct way is to list all the speeds in ascending order, and count from the highest value until 15% of the total number of values have been passed. The speed arrived at is the 85 percentile speed.

3.3.5.3 A quite different way of estimating the 85 percentile speed, and the only way that can be recommended for total samples of less than, say, 200 speeds such as may be obtained with a radar speedmeter is to make use of the well known shape of speed ~ distributions. They are, for all practical purposes, Gaussian (i.e. Normal). For a Normal Distribution, the 85 percentile is 1.037 standard deviations above the mean, where the standard deviation of speed,

$$v \text{ , is estimated as : } \sqrt{\sum (v - mean)^2 / (n-1)}$$

It is sufficiently accurate to take

85 percentile = mean + standard deviation

3.3.5.4 Separate calculation of either the 85 percentile speed or the standard deviation provides a useful check on the reliability of the measurements, since the ratio

$\frac{85\ percentile}{mean}$ or $\frac{Standard\ deviation}{mean}$

can then be compared with its expected value. Because the standard deviation of speeds is usually equal to about one sixth of the mean speed, the ratio :-

85 percentile/mean

usually lies in the range 1.1-1.25.

3.3.5.5 The following is an example of data analysis outlined above:-

If n values of speed (v) are measured, the mean and the standard deviation of the speed distribution from which the sample was taken are given by:-

Mean, $m = \sum v/n$ where $\sum$ denotes summation over all values.

Standard deviation, $s = \sqrt{\sum (v-m)^2 / n-1}$

For calculation purposes, a useful relationship is:-

$\sum(v - m)^2 = \sum v^2 - (\sum v)^2/n$

For example, if 150 speeds are measured, and the sum of the speeds is 7 500 and the sum of the squares of the speeds is 385 765, then:-

$m = \sum v / n = 7500 / 150 = 50.0$

$\sum (v-m)^2 = \sum v^2 - (\sum v)^2 / n$

$= 385\ 765 - 7\ 500^2/150$

$= 385\ 765 - 375\ 000$

$= 10\ 765$

$s = \sqrt{\sum (v-m)^2 / n-1}$

$= \sqrt{10765 / 149}$

$= \sqrt{72.25}$

$= 8.5$

Note that the standard deviation, 8.5, is approximately one sixth of the mean :-

$50 \div 6 = 8.3$

The 85 percentile is then given by

$v = m + s = 50 + 8.5 = \underline{58.5}$

which should be rounded to 59.

3.3.6 Measurement of Speeds by Radar Speedmeter for Determining Speed Limits

3.3.6.1 Speed limits are introduced as a means of controlling the speed of traffic along a road generally on the grounds that higher speeds would lead to accidents occurring. The guidelines and criteria for setting speed limits on new roads as well as for reviewing the existing speed limits are provided in Chapter 6 of Volume 6.

3.3.6.2 In evaluating speed limits along existing roads, as mentioned in Chapter 6 of Volume 6, one of the relatively important criteria is the 85 percentile speed, which is normally determined by the use of a radar speedmeter.

3.3.6.3 For speed limits, the appropriate 85 percentile speed is that determined from the measurement of the speed of cars under free flowing conditions. Cars are defined as private saloon cars, private estate cars, taxis, and hire cars but do not include vans, light buses, or light goods vehicles.

3.3.6.4 There is no generally accepted definition of “free-flowing conditions”. However, it may be stated that in free flow conditions, headways and lateral displacements are usually so large as to ensure that drivers are in no way prevented, by the close proximity of other vehicles, from driving at the speed of their own choice. The conditions cannot be measured precisely and so it must be a subjective judgement as to whether or not traffic is in a free flow condition. However, it may be helpful to suggest that free flow conditions are most unlikely to occur during well defined directional morning and evening peaks and times of high heavy vehicle flow.

3.3.6.5 The site, where the speeds of cars are to be measured, should be selected so that it is not too near each end of the section of road being examined. More than one site may be necessary if speeds vary along the section, which should itself be not less than 1km in length to avoid frequent changes in speed limit. The site conditions should generally be better than average over the section, so that the results obtained reflect a driver's free choice of speed.

3.3.6.6 To obtain the most representative results, the survey should be carried out in dry weather, on weekdays during off-peak periods when free-flowing conditions are likely to occur.

3.3.6.7 The general procedures for setting up and use of the radar speedmeter should follow those described in paragraph 3.3.4.3. Two observers should be employed, one reading the meter and the other recording the values.

3.3.6.8 At each observation point, the number of speeds measured will affect the reliability of the result as an estimate of the true value, obviously the larger the sample the better. For each observation point, a minimum total sample of 200 cars should be collected. Collection of data can be carried out on separate weekdays if necessary. On a two-way road, each chosen site should comprise two observation points, one for each direction of travel.

3.3.6.9 For a section of road under study, the samples of speed measurements collected from all observation points, in the case of two chosen sites on a two-way road, there will be 4 observation points, should be combined together. Based on this combined data, the 85 percentile speed of cars under free-flowing conditions is arrived at by following the method described in section 3.3.5.

3.4 Journey Time Survey

3.4.1 Journey Time Data

3.4.1.1 Journey time is the average observed time taken to travel a section of the network. It can be broadly classified into two categories, viz. car journey time and journey time by type of public transports, the latter includes bus, PLB, tram or ferry journey times etc.

3.4.1.2 Journey time data is of wide application such as for traffic assignment, economic assessment, "Before and After" study of implementation of traffic management schemes etc. Apart from these, car journey time data is useful for monitoring the level of traffic congestion.

3.4.1.3 Journey times may be observed in two different ways, by observing the times that a sample of vehicles take to travel the length of the survey section, or by driving a test vehicle in the traffic and recording its passage time.

3.4.1.4 Each basic method of measuring journey time has a number of alternative procedures and strategies for actual data collection. The travel time observation methods require observers at fixed points in the network, i.e. the observers are stationary. On the other hand in the test vehicle methods the observers move along in the traffic stream.

3.4.2 Moving Car (Original) Method

3.4.2.1 Of all the methods for observing car journey times, the most commonly used is the moving car method.

3.4.2.2 The moving car (original) method works in the following way. The driver of the test vehicle attempts to simulate an "average" vehicle in the traffic stream, by noting the number of vehicles that overtake the test car, and the number of vehicles that the test car overtakes. The driver tries to equate these two numbers of overtakings, and the test vehicle is said to be "floating" in the traffic if the two numbers are the same.

3.4.2.3 Where it is not possible to equate the numbers of overtakings by the end of the test section, a correction to the observed travel time may be made, using the following method. If I is the number of vehicles overtaken by the test vehicle and J is the number of vehicles that overtake the test vehicle. Then the estimated actual mean travel time T is given by

$$T = \frac{(I-J+qt(I,J))}{q} \quad (1)$$

where t(I, J) is the observed travel time and q is the mean flow rate.

3.4.2.4 However q is not directly recorded in the survey run, so it has to be found from some other source. This could be an external traffic count on the test section during the survey time or the observers could estimate q by making a return trip along the test section (i.e. in the opposite direction), and observe the return travel time (tr) and the number of vehicles encountered (M) travelling in the original flow direction. M will be equal to the number of vehicles in the test section at the beginning of the return run plus all those vehicles entering the test section during the time tr. It then follows that

$$q = \frac{(M-I+J)}{(t(I,J)+tr)} \quad (2)$$

So T may then be estimated using equation (2). Calculation of the number of runs required to obtain a mean travel time is detailed in section 3.4.3.

3.4.2.5 This method is not commonly used in view of its complexity. Another simplified method is described in the next paragraph.

3.4.3 Moving Car (Modified) Method

3.4.3.1 As described in section 3.4.2, the moving car (original) method requires not only the counting of all vehicles that overtake and are overtaken, but also the counting of vehicles in the opposite traffic stream. This becomes a problem under heavy traffic flows, particularly on 4 lane single carriageway and dual carriageway roads, and of course is not possible on one-way streets.

3.4.3.2 To overcome the problems of the original method, a modified method has been adopted, which requires only the test car to be driven as far as possible at speeds similar to those of the surrounding traffic thus the test car is considered to be travelling at the mean speed of traffic.

3.4.3.3 For conducting an area-wide car journey time survey, the general guidelines are as follows:

i) Before the start of the survey, a map indicating the road network being surveyed should be prepared.

ii) Since the survey will be carried out on route basis, detailed planning of each route is required. The length of each route should be such that its estimated journey time for a complete run would not exceed the prescribed peak/off-peak period.

iii) In case it is in doubt whether a planned route is workable, a "reconnaissance" should be carried out.

iv) A route is normally divided into a number of sections by checkpoints which are usually chosen at major junctions. During the survey the total journey time as well as the stopped times at traffic light, road junctions and delays due to congestion are recorded for each section. The centre of the junction should be used as the exact point for recording in order to facilitate adding up of journey times between sections.

v) Measurement of journey times should be started by first making a few initial runs on each route for determining the total number of runs required to meet a specific precision level of the survey results. Calculation of total number of runs is based on the following formula:

$$n = t^2 x \frac{s^2}{d^2}$$

when
n = total number of runs required
t = t value
s = standard error
d = marginal error
A marginal error of ±10% at 90% level of confidence has been adopted for existing area-wide car journey time surveys.

vi) From the results of survey, the mean journey time/journey speed for each section of road during respectively peak or off-peak periods are calculated and finally tabulated in the alphabetical order of the street name. The journey speed for inter-district routes will also be computed if the survey covers inter-district routes.

3.4.4 Bus Journey Time Survey

3.4.4.1 Measurement of average bus journey times along a section of the network can be carried out by two methods:

i) matching of registration numbers of the buses, or

ii) recording by observers travelling on board a sample of buses.

3.4.4.2 The matching of registration numbers has the advantage of using relatively small number of field observers to collect large number of samples, but requires longer time for subsequent data analysis.

3.4.4.3 Using observers travelling on board buses will require more field observers to collect the same number of samples, than using registration recording method, but the data obtained is more readily available for use as it requires little analysis. This method is also particularly useful for collecting information on the operating characteristics of specific bus routes, and this is more fully discussed in Chapter 5, which deals with public transport surveys.

3.4.4.4 The bus journey time survey methods are also applicable for measuring the journey times of both red and green minibuses.

3.4.5 Bluetooth Detector Method

3.4.5.1 The Bluetooth Detector Method is a means of measuring traffic journey time that relies on identifying the Bluetooth media access control (MAC) addresses of in-vehicle Bluetooth devices traveling along a road network. To obtain travel time measurements with Bluetooth devices, one must match an observed MAC address between at least two Bluetooth Detectors. Vehicle travel times and speeds can be determined by calculating the time required for vehicles containing Bluetooth devices to travel between two or more Bluetooth Detectors of known distance.

3.4.5.2 Captured data from Bluetooth Detectors can be transferred to a server over a wireless 4G/5G network or Ethernet cable, where the server matches the addresses and their respective time stamps to the same MAC address from any Bluetooth Detector along the road network. This data matching can also be done manually. Bluetooth Detectors can be placed anywhere near the road, provided there are no major sight obstructions. The reliable detection distance can reach up to 100 meters, allowing for flexibility in placement that may be particularly beneficial on roads with challenging topographies. The units can be powered by existing power infrastructure, such as lampposts, or solar panels. Battery-powered units can usually run for two to three weeks on a single charge, and their low power consumption is a particular benefit when infrastructure power is not available.

3.4.5.3 Adopting the Bluetooth Detector Method allows for data collection 24/7, without constraints on the time period for data collection throughout the day. This approach allows for a sufficiently large sample size of data, with limited manpower necessary for system maintenance and data processing. It also eliminates the need for field observers compared to traditional survey methods of driving a test car and collecting a limited number of samples, while avoiding human errors in recording and inputting data.

3.4.5.4 When deciding on locations for detector installation, data accuracy and analysis must be taken into account. Common considerations include non-traffic disturbance, such as pedestrians and cyclists next to the road, frequent stop-and-go traffic, such as buses stopping along the road, and suitable configuration on pairing and matching Bluetooth Detectors for analyzing meaningful journey time figures.

3.4.5.5 The consideration described above leads to limitations on suitable installation locations of Bluetooth Detectors. Road junctions and merging/diverging points should be the most preferred installation points for potential pairing and matching in data analysis. Ensuring a unique route choice between any paired Bluetooth Detectors may require installing or pairing/matching additional detectors in the

middle of the concerned road section.

3.4.5.6 The Bluetooth Detector Method is well-suited for measuring journey times along traffic only road sections with no stop-and-go activities, such as expressways and urban/rural trunk roads. However, for primary distributors, rural roads, and district distributors, a detailed investigation should be conducted on roadside facilities and traffic movement before adopting this method.

3.4.5.7 The Bluetooth Detector Method also enables continuous monitoring of traffic pattern and easy spotting of traffic congestion by extracting journey time figures in the server. Moreover, past records of traffic journey time may help reveal seasonal effects, drawing trends on travel speeds.

4.1 References

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(3) HONG KONG GOVERNMENT OVE ARUP & PARTNERS, “Parking Demand Study”, 1995.

(4) HONG KONG GOVERNMENT SCOTT WILSON KIRKPATRICK AND PARTNERS, “Freight Transport Study”, 1994.

(5) “The White Paper on Transport Policy in Hong Kong”. The Transport Branch, Government Secretariat, Hong Kong (January 1990).

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4.2 Introduction

4.2.1 Parking facilities are an integral part of a transport system. As vehicles are usually parked for the major part of a day, the provision of appropriate parking facilities could help minimise the level of traffic congestion and resultant frustration of road users.

4.2.2 A derivation of the need for parking must be based on reliable data on the demand for parking and the availability of parking facilities to satisfy that demand.

4.2.3 The collection of data relating to the capacity and use of existing parking facilities, their location, and the parking characteristics of motorists that use the facilities as well as those that do not do so but park illegally, forms the basis of quantifying the demand side of the equation. Parking surveys are usually conducted to collect such data.

4.2.4 As stated in Volume 7, the parking demand should be estimated for a pre-selected future year through a relationship with travel demand obtained by the application of an appropriate transport modelling procedure. Such demand is often referred to as a 'latent demand'.

4.2.5 The latent demand is a parking demand that could arise from the travel demand estimated in a future year resulting from any vehicle ownership or usage restraint policies that may be implemented at the time. It is a demand that must be provided, if the road system is to function as anticipated, and parking is to be conducted in an orderly manner.

4.2.6 There is also a 'revealed demand' that could be determined by conducting appropriate parking surveys. These include observations of vehicles that are parked both legally and illegally.

4.2.7 The 'revealed demand' is usually less than the 'latent demand' and is influenced by the number and the location of available parking spaces. It is also influenced by the level of enforcement, as strict enforcement tends to discourage illegal parking activity.

4.2.8 The rest of this Chapter provides guidance on the methodology used in conducting surveys to establish the quantity, type and location of existing parking facilities, the utilisation of those facilities, the parking characteristics of motorists, and the quantity, type and location of the revealed demand for parking.

4.2.9 Detailed instructions for the use of the personnel engaged in a survey are usually distributed to them in advance of the date of commencement of the survey. The instructions provide specific guidance to each category of personnel (supervisors, enumerators, observers, interviewers etc.) as to their duties in the performance of the survey and is usually accompanied by a work roster. In the more complicated surveys the instructions are covered at a verbal briefing to ensure that the procedures are well understood.

4.2.10 It is not the purpose of this document to include such instructions as, apart from the technical requirements, they are dependent on site conditions, staff availability and other variable circumstances.

4.3 Parking Inventory Survey

4.3.1 General

4.3.1.1 A fundamental part of any parking survey is the preparation of an inventory of parking facilities. It is a statistic of the parking supply available at a point in time.

4.3.1.2 TPDM Volume 7, Chapter 3 provides guidance on the use of the parking inventory. As stated therein, a comprehensive on-street and off-street parking inventory has been established since the completion of the First Parking Demand Study in 1995, the methodology for conducting a parking inventory survey will be briefly covered in this chapter.

4.3.1.3 A parking inventory survey is very time and resource consuming, particularly when it covers the entire Territory. Hence, a parking inventory should be regularly updated to avoid the need to repeat an inventory survey. At present the Traffic and Transport Survey Division is the coordinator for the updating of the parking inventory.

4.3.1.4 Because of the large manpower resource required and the simplistic nature of the data collection process, students are usually engaged during the summer vacation to conduct an inventory survey. As the survey is not affected by seasonal variation, it could be spread over a length of time without distortion of the results.

4.3.1.5 The planning of a survey is crucial if the large manpower resource engaged in the survey is to be optimised.

4.3.2 Planning

4.3.2.1 As mentioned in Volume 3 Chapter 7, a full parking inventory survey should be avoided because the parking inventory could be obtained by other means. It is recommended that surveys should only be conducted to verify the information.

4.3.2.2 In the urban area a parking inventory is best conducted on foot, because of the dense street network and the small size of the average street block to be visited. Hence, the first task is to determine the area that one person could cover in the course of a single day for the purpose of recording the number of on-street and off-street parking spaces.

4.3.2.3 Based on that estimation the area to be surveyed (study area) is divided into units of a size that could be surveyed by one observer in one day.

4.3.2.4 In the sub-urban areas, due to the sparse road system and the larger size of block or village cluster, it could be more efficient to use a vehicle for the survey than travel by foot. The area to be surveyed should be similarly divided into units dependent on the mode of travel to be used.

4.3.2.5 The number of units that divides the study area provides an estimation of the man-days required for the field observations.

4.3.2.6 For transport planning, the Territory is divided into traffic zones for the purpose of aggregating socio-economic household characteristics for estimating travel demand. At present CTS-3 zoning system, which contains 329 zones, has been used in the parking inventory.

4.3.2.7 Information relating to parking is usually collected on the basis of each street block. It could then be aggregated on the basis of the traffic zoning system. Special attention should be given when collecting data to study areas where the street block and CTS traffic zone do not share a common boundary.

4.3.3 Field Observations

4.3.3.1 Each observer should use two ‘Parking Space Inventory Sheets’, one for on-street inventory and another for off-street inventory, to record the parking space information at each street block or village cluster. Diagram 4.3.1 shows the inventory sheet used to record information relating to parking spaces on that side of the street that surrounds the block in question. Diagram 4.3.2 shows the inventory sheet used to record information of parking spaces provided within the block.

4.3.3.2 Prior to the commencement of field observations, each observer should fill in the details on the upper section of each inventory sheet as shown in the Diagrams 4.3.1 and 4.3.2.

4.3.3.3 The shape of the street block should be drawn and the street names marked appropriately. The block faces are numbered in a clockwise manner commencing with the face on the right side of the uppermost apex.

4.3.3.4 On the day of survey the observer should walk along every street block within the survey area. He/she would record for each block face, the number of parking spaces of a relevant type at each location. Normally each individual space is demarcated by road markings, and the type of vehicle permitted to park is indicated on road signs at each end of the parking place.

4.3.3.5 However, where public service vehicles are permitted to park at an on-street stand or stopping place, the number of parking spaces is estimated from the length of the demarcated stand. As indicated in Volume 7, Chapter 3 the estimate is based on a module length of 5m for a taxi, 8m for a public light bus and 12m for a bus.

4.3.3.6 Unless the traffic signs specified in regulation 34 of the Road Traffic (Public Service Vehicles) Regulations are erected at a public service vehicle stand, parking is not permitted. Hence, no spaces should be included in the inventory even though parking does occur, albeit illegally.

4.3.3.7 Any off-street parking facilities within the study area should be visited and the available parking spaces appropriately inventorised. Not all off-street parking facilities are likely to be properly demarcated. At those locations that are inadequately marked, the parking provision would need to be estimated by counting the number of parked vehicles, preferably at the time of peak occupancy.

4.3.3.8 Should an observer experience difficulty in gaining access to an off-street parking facility, the observer should attempt to obtain the relevant information from the property management officials. Alternatively, the information should be obtained from the building plans and records registered at the Buildings Department.

4.3.3.9 To alleviate the parking deficiency problem, some sites are leased on a short term tenancy (STT) as an off-street parking lot. Others may be used temporarily as parking lots while awaiting building construction to commence. A remark to that effect should be made in the inventory sheet so that the temporary nature would be reflected in the final production of the parking inventory.

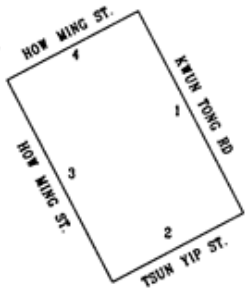
4.3.3.10 Any on-street parking spaces that are temporarily not available through closure by the police, should not be removed from the inventory as these are for short periods up to 72 hours. However, designated spaces are made unavailable for periods in excess of 72 hours because of building construction in an adjacent site, a remark should be made to that effect in the inventory sheet and the spaces accounted for as appropriate.

DIAGRAM 4.3.1: PARKING SPACE INVENTORY SHEET ON-STREET

Observer : 120 DISTRICT : _____

Date of Survey : 13 / 8 / 1999 CTS ZONE NO. : _____

Location detail : - Remarks : -



	TYPE		FACE 1			FACE 2			FACE 3			FACE 4			FACE 5			FACE 6		
			GV	Car	Coach	GV	Car	Coach	GV	Car	Coach	GV	Car	Coach	GV	Car	Coach	GV	Car	Coach
METERED	½ hr	$4 / ½ hr																		
	1 hr	$2 / ½ hr																		
	2 hr	$2 / ½ hr																		
		$4 / ½ hr																		
NON - METERED																				
	CAR / VAN																			
	GOODS VEHICLE																			
	OVERNIGHT GOODS VEHICLE																			
	MOTOR CYCLE																			
	COACH / BUS																			
	GOVN. SPECIAL VEH. - POLICE, AMBULANCE, FIRE ENGINE, POST CAR																			
	REFUSE COLLECTION VEH.																			
	DISABLED PARKING																			

DIAGRAM 4.3.2: PARKING SPACE INVENTORY SHEET OFF-STREET

Observer : 120 DISTRICT : _____

Date of Survey : 13 / 8 / 1999 CTS ZONE NO. : _____

Location detail : - Remarks : -

TYPE		Method of fee collection	CLASS OF VEHICLE								REMARKS
			CAR	GV	TAXI	PLB	BUS COACH	FRAN. BUS	RCV / GOVT. VEH.	TOTAL	
Public	STT	Ticket									
		Other									
	Garage	Ticket									
		Other									
Private	STT	Ticket									
		Designated free									
		Designated for Owner									
		Other									
	Garage	Ticket									
		Designated free									
		Designated for Owner									
		Other									

4.3.4 Data Analysis

4.3.4.1 The analysis of data collected during a parking inventory survey is fairly simple. The summation of the information collected provides an indication of the number of on-street and off-street parking spaces available within the study area.

4.3.4.2 The information is available by street name, designated spaces by vehicle type, metered spaces by duration and vehicle type, public off-street spaces by permitted vehicle type and charges, as well as private off-street spaces by permitted vehicle type.

4.3.4.3 The information can be presented in any combination of those individual characteristics, dependent upon the purpose for which the survey is conducted.

4.3.4.4 The usual practice is to summarise the data by District Council boundary as indicated in Table 4.3.1. As seen from Table 4.3.2 the inventory is available by CTS traffic zone to facilitate a direct comparison of parking supply with an estimate of future zonal demand.

Table 4.3.1 Overall Parking Inventory By District

DISTRICT	ON-STREET PARKING INVENTORY												OFF-STREET PARKING INVENTORY							GRAND TOTAL
	METERED				NON-METERED							TOTAL								
	U	G	C	Total	P	G	OG	B&C	M	O	Total		P	C	L	H	T	M	Total	
A	379	101	8	488	33	0	46	1	353	14	447	**935**	34989	42	698	148	22	275	**36174**	**37109**
B	1121	6	28	1155	32	0	0	1	459	15	508	**1663**	30688	116	100	1	6	276	**31187**	**32850**
C	461	54	23	538	9	0	15	0	188	8	220	**758**	42106	133	1741	641	41	995	**45657**	**46415**
D	431	79	32	542	322	22	33	16	202	19	614	**1156**	33503	197	674	252	6	757	**35389**	**36545**
E	1828	381	132	2341	19	74	5	0	803	11	912	**3253**	20507	89	2583	324	2	98	**23603**	**26856**
F	1295	190	1	1486	23	0	91	2	407	26	549	**2035**	25990	199	2007	859	1517	284	**30856**	**32891**
G	2591	191	45	2827	21	4	23	0	600	5	653	**3480**	40032	122	1157	556	4	327	**42198**	**45678**
H	373	134	0	507	53	15	23	0	179	4	274	**781**	14103	90	795	182	2	864	**16036**	**16817**
J	377	67	14	458	10	15	25	2	191	6	249	**707**	30657	110	2281	810	99	1060	**35017**	**35724**
K	424	54	8	486	298	9	0	12	116	54	489	**975**	24650	38	1047	367	29	159	**26290**	**27265**
L	818	108	16	942	233	98	106	5	111	9	562	**1504**	36551	107	1454	909	162	474	**39657**	**41161**
M	459	111	3	573	615	214	190	13	154	0	1186	**1759**	23671	200	1152	591	140	292	**26046**	**27805**
N	431	179	2	612	896	154	131	8	36	22	1247	**1859**	17368	47	662	462	366	201	**19106**	**20965**
P	739	118	31	888	83	0	165	7	83	4	342	**1230**	19817	31	806	382	39	297	**21372**	**22602**
Q	612	174	27	813	1228	178	43	73	111	12	1645	**2458**	21830	132	383	399	27	1128	**23899**	**26357**
R	695	133	17	845	689	23	58	31	151	20	972	**1817**	64747	277	2154	1134	236	1140	**69688**	**71505**
S	482	116	2	600	155	0	275	36	177	38	681	**1281**	35920	86	2803	2104	5001	1060	**46974**	**48255**
T	0	0	0	0	4	1	0	0	0	0	5	**5**	6941	314	0	592	0	35	**7882**	**7877**
TOTAL	13516	2196	389	16101	4723	807	1230	207	4321	268	11555	**27656**	524070	2330	22497	10713	7699	9722	**577031**	**604687**

NOTES:

A CENTRAL & WESTERN
B WAN CHAI
C EASTERN
D SOUTHERN
E YAU TSIM MONG
F SHAM SHUI PO
G KOWLOON CITY
H WONG TAI SIN
J KWUN TONG
K TSUEN WAN
L TUEN MUN
M YUEN LONG
N NORTH
P TAI PO
Q SAI KUNG
R SHA TIN
S KWAI TSING
T NORTH LANTAU

NOTES:

P - Cars/Vans
C - Coaches/Buses
G - Goods Vehicles
OG - Overnight Goods Vehicles
L - Light Goods Vehicles
H - Heavy Goods Vehicles
T - Container Vehicles
M - Motor Cycles
O - Bus, Coaches, and Special Vehicles
U - Unclassified

Table 4.3.2 Parking Inventory by CTS Zone

CTS ZONE	ON-STREET												OFF-STREET							GRAND TOTAL
	METERED				NON-METERED							TOTAL								
	P	G	C	Total	P	G	OG	C	M	O	Total		P	C	L	H	T	M	Total	
1	13	18	0	31	1	0	10	0	40	2	53	**84**	1764	7	52	91	0	13	1927	**2011**
2	0	32	0	32	0	0	19	0	10	0	29	**61**	52	0	84	0	0	0	136	**197**
3	34	0	0	34	0	0	17	0	25	1	43	**77**	1406	0	506	0	22	25	1959	**2036**
4	16	0	0	16	4	0	0	0	58	1	63	**79**	471	2	0	0	0	0	473	**552**
5	0	0	0	0	2	0	0	0	11	0	13	**13**	1474	1	4	0	0	5	1484	**1497**
6	30	0	1	31	2	0	0	0	23	3	28	**59**	414	0	0	0	0	0	414	**473**
7	15	0	0	15	0	0	0	0	31	3	34	**49**	403	0	0	0	0	0	403	**452**
8	0	0	0	0	0	0	0	0	0	0	0	**0**	503	0	0	0	0	0	503	**503**
9	0	0	0	0	0	0	0	0	10	0	10	**10**	145	0	0	0	0	2	147	**157**
10	0	0	0	0	0	0	0	0	50	0	50	**50**	629	0	0	0	0	1	630	**680**
11	0	0	0	0	0	0	0	0	58	0	58	**58**	1756	0	0	0	0	54	1810	**1868**
12	11	0	0	11	0	0	0	0	0	1	1	**12**	4736	4	0	0	0	42	4782	**4794**
13	86	0	2	88	0	0	0	1	26	2	29	**117**	8596	16	0	0	0	0	8612	**8729**
14	12	0	0	12	0	0	0	0	5	0	5	**17**	3164	0	0	2	0	36	3202	**3219**
15	0	0	0	0	0	0	0	0	0	0	0	**0**	2674	0	16	0	0	40	2730	**2730**
16	124	0	0	124	4	0	0	0	170	9	183	**307**	1901	0	0	0	0	1	1902	**2209**
17	67	0	2	69	4	0	0	0	79	1	84	**153**	935	7	6	0	0	1	949	**1102**
18	208	0	1	209	4	0	0	1	29	2	36	**245**	1493	0	0	0	0	0	1493	**1738**
19	53	0	0	53	6	0	0	0	43	0	49	**102**	1385	3	0	0	0	0	1385	**1487**
20	178	0	0	178	0	0	0	0	47	1	48	**226**	1514	1	0	0	0	21	1536	**1762**

Notes : Vehicle Types P - Cars/Vans M - Motor Cycles C - Coaches/Buses
O - Buses, Coaches and Special Vehicles
G - Goods Vehicles
OG - Overnight Goods Vehicles
L - Light Goods Vehicles
H - Heavy Goods Vehicles
T - Container Vehicles

4.4 Parking Demand Surveys

4.4.1 General

4.4.1.1 As previously mentioned parking demand could be a 'latent demand' or a 'revealed demand'. The 'revealed demand' is usually less than the 'latent demand' and is influenced by the availability of parking spaces and the level of enforcement exercised against illegal parking.

4.4.1.2 Most parking demand data collected by field surveys indicate the extent of revealed demand at the time of survey. The type of parking demand data collected may include :-

- Spatial distribution of parking demand.
- Total number of parking spaces in the study area over the study period.
- Parking duration.
- Trip origin, purpose and destination.
- Other parking characteristics associated with demand.

4.4.1.3 The survey procedures discussed in this section are divided into observational surveys and interview surveys.

4.4.2 Observational Surveys

4.4.2.1 A popular type of parking observation survey is a patrol survey. This approach involves an observer walking, or being driven, along a pre-determined route at fixed time intervals.

4.4.2.2 The number of parked vehicles, their location and type is usually recorded during each routine observation. The vehicle registration number may also be recorded if the survey is intended to determine parking duration characteristics.

4.4.2.3 The data collected during the survey may be used to determine :-

- the Parking Level,
- the Parking Duration.

4.4.2.4 A vehicle is said to be parked if it is standing still, whether occupied or not, unless

i) it is part of a traffic stream waiting to move, or

ii) is standing temporarily for the purpose of and while engaged in loading or unloading or picking up or setting down passengers, or

iii) is involved in an accident or stopped by a law enforcement officer, or

iv) is an emergency service vehicle (e.g. fire service appliance, ambulance etc.)

4.4.3 The Parking Level Survey

4.4.3.1 The purpose of the parking level survey is to establish the parking demand revealed in an area. The area may cover a specific parking facility, a traffic zone, a District Council Area, a sub-regional area or the entire Territory.

4.4.3.2 Parking is usually associated with the activity that occurs at the trip destination. In broad terms it is classified as residential or non-residential parking.

4.4.3.3 During the 24-hour period there is movement between the residential and non-residential parking demand in respect of time and location. Previous parking studies conducted in the Territory have shown that during certain periods of a weekday, the parking level is steady and the parking turnover is reasonably constant.

4.4.3.4 Those periods are established as :-

i) Between 0930 and 1230 (morning level).

ii) Between 1430 and 1630 (afternoon level).

iii) Between 0000 and 0500 the next day(night level).

4.4.3.5 The night level is representative of the residential parking demand. The morning or afternoon level could represent residential, non-residential or a mixed demand dependent on the particular characteristics of the location studied. Often there is little difference between the demand level during the morning and afternoon periods, and either period may be used.

4.4.3.6 Parking level surveys should generally not be conducted outside the stated periods as misleading results may be derived due to a fluctuating turnover.

4.4.3.7 For the purpose of survey, the study area should be divided into sections sufficiently small for each to be covered by one observer during each specific time period indicated above. Patrolling by car enables larger sections to be covered in a given time interval but a driver and observer are required. For security reasons patrolling by car is usually a necessity for night observations.

4.4.4 Field Observations for Parking Level Survey

4.4.4.1 The observations are conducted in a similar manner to those in the parking inventory survey, except that in the parking level survey the number of parked vehicles and not the number of parking spaces are observed. Furthermore, an observer covers each area three times a day, once during each period indicated in paragraph 4.4.3.4. As an alternative, the parking level survey could be conducted at night when the parking condition is generally the most critical.

4.4.4.2 Observations are usually conducted on foot or by travelling around in a vehicle. As stated previously a vehicle is usually used at night for security reasons to drive each observer around the area to be covered by him/her. Diagram 4.4.1 is an illustration of a field sheet used to record on-street parking level observations.

4.4.4.3 The total number of vehicles that are observed parked in each section of the street block face which is metered, is recorded in the appropriate category according to the class of vehicles already identified. A coach parked in two metered spaces will be recorded as one coach. Three vans parked in two goods vehicle spaces should be recorded as three goods vehicles.

4.4.4.4 Similarly, the number of vehicles parked in designated parking spaces are recorded for each block face.

4.4.4.5 The total number of vehicles that occupies a section of the block face, which is neither metered nor designated, is recorded by class of vehicle. It would include those vehicles parked on the footpath, centre islands etc. Thus, all vehicles parked along a block face, whether in marked locations or elsewhere, will be recorded. The same process is repeated for the other faces of the street block and other blocks in the area to be surveyed.

4.4.4.6 Alternatively, a survey of illegal on-street parking should be conducted to provide an indication on the extent of the shortage of parking spaces. The survey should be conducted around midnight so that the most critical condition could be captured.

4.4.4.7 Likewise, the number of vehicles that are parked within the block, in off-street open lots or parking garages is recorded in Diagram 4.4.2. There should be a distinction between the class of vehicle parked and on whether the parking facility is open to the public.

4.4.4.8 The parking level survey must include all parked vehicles irrespective of how or where they are parked, so long as they are parked in a position where any vehicle driver could park his vehicle.

4.4.4.9 The provision of temporary overnight parking spaces at sites leased on a short term tenancy (STT) has played an important role in alleviating the parking deficiency problem. A survey on the utilization rate of STT sites in each District is useful in monitoring the parking demand in the District and its vicinity and in devising a rolling programme for a reprovision of termination of existing STT vehicle parking sites. The parking level survey of STT sites may also be accompanied by a parking inventory survey during daytime.

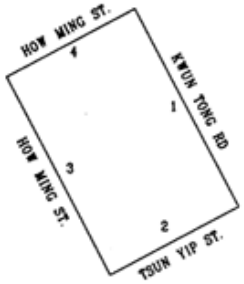
DIAGRAM 4.4.1: ON-STREET PARKING LEVEL FIELD SHEET

Observer : 120 DISTRICT : _____

Date of Survey : 13 / 8 / 1999 CTS ZONE NO. : _____

Location detail : - Time periods: _____

Remarks : -



	TYPE \ FACE	1			2			3			4			5			6		
METERED	TYPE	GV	Car	Coach	GV	Car	Coach	GV	Car	Coach	GV	Car	Coach	GV	Car	Coach	GV	Car	Coach
	½ hr — $4 / ½ hr																		
	1 hr — $2 / ½ hr																		
	2 hr — $2 / ½ hr																		
	2 hr — $4 / ½ hr																		

NON - METERED		D	O	D	O	D	O	D	O	D	O	D	O
	CAR / VAN												
	GOODS VEHICLE												
	OVERNIGHT GOODS VEHICLE												
	MOTOR CYCLE												
	COACH / BUS												
	GOVN. SPECIAL VEH. - POLICE, AMBULANCE, FIRE ENGINE, POST CAR												
	REFUSE COLLECTION VEH.												
	DISABLED PARKING												

DIAGRAM 4.4.2: OFF-STREET PARKING LEVEL FIELD SHEET

Observer : 120

Date of Survey : 13 / 8 / 1999

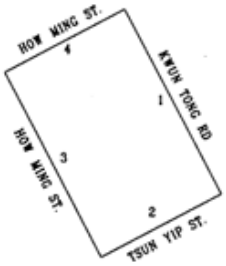
Location detail : -

DISTRICT : _____

CTS ZONE NO. : _____

Time periods: _____

Remarks : -



TYPE		Method of fee collection	CLASS OF VEHICLE								REMARKS
			CAR	GV	TAXI	PLB	BUS COACH	FRAN. BUS	RCV / GOVT. VEH.	TOTAL	
Public	Lot	Ticket									
		Other									
	Garage	Ticket									
		Other									
Private	Lot	Ticket									
		Designated free									
		Designated for Owner									
		Other									
	Garage	Ticket									
		Designated free									
		Designated for Owner									
		Other									

4.4.5 Data Analysis for Parking Level Survey

4.4.5.1 As with the parking inventory field observations, the data analysis is fairly simple.

4.4.5.2 The information is available by the class of vehicle parked in each type of facility in each street block and includes the extent of parking that occurs outside of the marked areas. It can be presented in any combination of individual characteristics, dependent on the purpose for which the observations are made.

4.4.5.3 A format recommended for the presentation of on-street and off-street parking level observations is illustrated in Tables 4.4.1 and 4.4.2 respectively. The revealed adequacy or deficiency of the available parking provision is very easily recognized from an estimate of the 'percent of space occupied'.

4.4.5.4 A value in excess of 100 indicates that parking demand exceeds supply and vice versa. However, the magnitude of the deficiency is best assessed by studying the percent of space occupied combined with the total number of parked vehicles within the study area or District during a particular time period. Thus, it could be said that although the percent of space occupied in traffic zone 25 is much larger than that in zone 24, the parking problem in zone 24 is more acute because of the much larger number of illegally parked vehicles in the zone, despite the availability of a large number of parking spaces thereat.

4.4.5.5 The interpretation of the combination of on-street and off-street parking level observations is also important to obtain a realistic picture of a parking deficiency. It would appear that a better utilisation of the available off-street facilities in traffic zone 24 could considerably reduce the extent of illegal on-street

parking within the zone, particularly at night time.

4.4.5.6 Whether the parking deficiency is related to demand from goods vehicles, private cars or both could be identified from the tabulation. Whether the deficiency is more severe at night or during daytime is also clearly seen. In fact, a diagrammatic presentation of the results using histograms could prove very effective.

Table 4.4.1 On-street Parking Level - District Council Area

Traffic Zone	Total On-Street Spaces	Time	METERED P/C	METERED G/V	METERED B	DESIGNATED P/C	DESIGNATED G/V	DESIGNATED B	OTHER P/C	OTHER G/V	OTHER B	Total Parked	Percent of Space Occupied
20	486	a.m.	269	22		89	53		209	193	4	839	172.6
		p.m.	267	28		85	32		249	166	1	828	180.4
		m.n.	271	56		71	36	1	313	169	1	918	188.9
21	817	a.m.	563	42		31	56	1	172	92	1	958	117.3
		p.m.	555	40		43	57	1	182	100	1	979	119.8
		m.n.	574	59		21	54		353	131		192	145.9
22	1149	a.m.	335	16		689	109		515	139	1	1804	157.0
		p.m.	338	18		660	113		416	122		1682	146.4
		m.n.	373	17		777	127	1	832	151	7	2285	198.9
23	30	a.m.				20	17					37	123.3
		p.m.				22	20					42	140.0
		m.n.				29	27					56	186.7
24	1076	a.m.				704	338		665	407	1	2115	196.6
		p.m.				717	330		733	409		2189	203.4
		m.n.				798	453		947	776	6	2980	276.9
25	56	a.m.				56	3		107	36		202	360.7
		p.m.				57	1		98	3	1	190	339.3
		m.n.				57			240	37	3	337	601.8
26	488	a.m.	170	10		284	11		199	12		686	140.6
		p.m.	171	11		266	12		218	15	1	694	142.2
		m.n.	191	13		282	3		278	12	2	781	160.0
27	161	a.m.				123	5		86	2	5	221	137.3
		p.m.				127	4		93	3	4	231	143.5
		m.n.				135	13		212	18	4	382	237.3

Table 4.4.2 Off-street Parking Level - District Council Area

Traffic Zone	Total On-Street Spaces	Time	PUBLIC GARAGE P/C	PUBLIC GARAGE G/V	PUBLIC GARAGE B	PUBLIC LOT P/C	PUBLIC LOT G/V	PUBLIC LOT B	PRIVATE GARAGE P/C	PRIVATE GARAGE G/V	PRIVATE GARAGE B	PRIVATE LOT P/C	PRIVATE LOT G/V	PRIVATE LOT B	Total Parked	Percent of Space Occupied
20	58	a.m.										12	2		14	24.1
		p.m.										11	5		16	27.6
		m.n.													0	0
21	70	a.m.				3	3					14	1		21	30.0
		p.m.						6				9	1		16	22.9
		m.n.				16	6						14		36	51.4
22	1355	a.m.	658	11					221	3		269	6		1168	86.2
		p.m.	731	14					242	4		291			1282	94.6
		m.n.	32	3					32			83			150	11.1
23	626	a.m.	428	20		1	1								450	71.9
		p.m.	550	10		1		2				nbsp;			563	89.9
		m.n.	422	12											434	69.3
24	2153	a.m.				971	25		109	3		340	24		1422	66.0
		p.m.				848	15		102	10	1	247	20		1245	57.8
		m.n.				83	16		14	6		47			166	7.7
25	0	a.m.											1		1	-
		p.m.										2	1		3	-
		m.n.													0	-
26	1149	a.m.	688	15		277	26	5	1	1		25			1038	90.3
		p.m.	697	17		285	18					22	1		1040	90.5
		m.n.	218	14		71	39	1				11			354	30.8
27	123	a.m.							13	3		69		11	96	78.0
		p.m.							11	2		72		12	97	78.9
		m.n.							2			32	14		48	39.0

4.4.6 Other Parking Characteristics from a Patrol Survey

4.4.6.1 By reducing the size of the area to be covered by each observer, the area could be covered at shorter intervals of say half or one hour instead of the long interval used in the parking level survey. Each study section must be small enough for an observer to cover its length and return to the start within the time allotted.

4.4.6.2 If the area to be surveyed could be divided into a series of closed loop circuits, the time spent in returning to the start can be eliminated, and the observers used more efficiently.

4.4.6.3 While walking through each circuit the observer should record the location of parked vehicles, the type of vehicle and registration number. To reduce the amount of writing by the observer while patrolling the circuit, the field sheet should be designed such that only the vehicle registration number need be recorded. To further reduce the observers writing time, only a pre-selected number of digits from the registration plate may be recorded.

4.4.6.4 The number of times a vehicle is observed in the same parking space multiplied by the observation interval, gives an indication of the parking duration.

4.4.6.5 A comparison of the vehicle registration numbers recorded during one time interval with that recorded in the previous interval, shows the number of arrivals and departures. The information should be used to prepare a parking accumulation profile which would indicate the pattern of utilisation of the parking facilities.

4.4.6.6 A knowledge of the number of parking spaces available and the number of vehicles that used the facility, would indicate the parking turnover of that facility. A high turnover and low average duration will indicate a demand for short term parking, and vice versa.

4.4.6.7 A summation of the parking duration when compared with the space-time availability provides a measure of the space utilisation.

4.4.6.8 The above mentioned parking characteristics may be determined for an entire day or specific time periods as warranted.

4.4.6.9 When conducting a patrol survey, whether it be by foot or in a vehicle, the observer should only record what existed when he passed the parking place. Provision should not be made for what he saw as he approached the parking place or had left it.

4.4.6.10 It is important that the recording of number plates is done as inconspicuously as possible. Motorists may change their normal habits if they are aware they are being observed, unless the survey has been given adequate publicity to put their minds at ease.

4.4.6.11 A disadvantage of the patrol survey is that many short term parkers may be missed. The number likely to be missed would depend on the interval of observation and the distribution of parking duration. Should such a possibility exist, a sample survey should be conducted to determine the general shape of the distribution and suitable adjustments made using the results of the sample survey.

4.4.7 A Cordon Observation Survey

4.4.7.1 If the study area is small, travel time inside the cordon is minimal, and there are only a very few entry and exit cordon points providing access to the study area, cordon observations could be used to obtain information relating to the parking characteristics within the study area.

4.4.7.2 Observers stationed at the cordon points should record the vehicle registration number, vehicle type and the times of arrival and departure at the cordon point during the survey period. The information could be used to determine the following characteristics :

- Total number of parkers;
- Arrival and departure rates;
- Composition of the vehicle population;
- Parking accumulation; and
- Parking duration.

4.4.7.3 Other characteristics such as the parking turnover and space utilisation could be derived from the available information.

4.4.7.4 Immediately prior to the commencement of the survey, the vehicle type and registration number of all vehicles parked within the study area should be recorded. It provides the base from which the parking accumulation diagram is prepared and the other characteristics are derived. A similar observation could be made at the end of the survey period to serve as a cross check of the survey observations, but is not essential.

4.4.7.5 The parking duration of individual vehicles is derived by matching the vehicle registration number and the respective times of arrival and departure. As the process is very time consuming if done manually, a computer programme would speed up the data analysis.

4.4.7.6 To obtain a more accurate assessment of the parking duration, the average travel time within the cordon area should be pre-surveyed and used in the analysis of arrival and departure times.

4.4.7.7 If the cordon points are suitably located, motorists could be interviewed on departure to obtain additional parking characteristics information. Questions asked in the interview may relate to the :

- Trip purpose;
- Final destination of trip;
- Origin of trip;
- Places visited;
- Nature of parking (metered, designated, private garage, open carpark etc.);
- Cost of parking;
- Duration of parking;
- Alternative parking locations considered; and
- Frequency of parking in the study area.

4.4.7.8 Interviews on departure are preferred to arrival interviews. The information received from the departing interviewee is more accurate as it is based on very recent experience fresh in the mind of the interviewee. Interviews should be short and the questions so worded as to derive a clear and specific response.

4.4.7.9 A pre-coded questionnaire should be designed to require a single tick in an appropriate cage, as it would save time during the interview and in subsequent data analysis. The questionnaire should be designed to suit the specific objective of the survey.

4.4.8 The Use of Available Data

4.4.8.1 At present all public owned off-street parking facilities and a majority of facilities under private ownership have been brought under the management of experienced car park operators. As a result there is available well documented information that could be used to determine parking characteristics at a particular facility, without the need for a special survey.

4.4.8.2 A combination of the available information from several facilities in an area could be used to determine parking characteristics in the selected area.

4.4.8.3 As information is usually available for each day in a year and over a period of years, any trends in a change of parking characteristics could readily be identified.

4.4.8.4 Some of the parking characteristics that can be derived from data extracted from records maintained by the operators are as shown below :-

(A) Parking Volume and Turnover

(i) Hourly, daily, monthly, annual;

(ii) User composition - monthly pass, parking tickets;

(iii) Parking Rates

(iv) Parking accumulation pattern;

(v) Space utilisation;

(vi) Parking duration; and

(vii) Variation in the above characteristics by time period and location of parking facility.

(B) Characteristics of Monthly Pass Parkers

(i) Distribution by location of facility;

(ii) Parking frequency;

(iii) Stability of patronage;

(iv) Ownership - individual/company; and

(v) Vehicle type - car, goods vehicle.

(C) Parking Revenue

4.4.8.5 Other characteristics like trip purpose, trip origin/ destination, walking distance etc. could only be determined by conducting an interview or mail questionnaire survey.

4.4.9 Interview Surveys

4.4.9.1 If parking demand is to cover a large geographic area, and it is expected that changes in parking supply could cause a substantial change in the parking characteristics, an interview technique may be necessary to collect the required data. Four techniques commonly used are an interview of the person parking, reply paid questionnaire, home interview survey and site specific interview surveys.

4.4.9.2 In a survey that involves an interview of the person parking, an interviewer should be assigned to a predetermined number of parking spaces. That number would depend upon several factors, and would include primarily the survey objective, the size of the survey site, the size of sample required to be statistically representative, the staff availability, the extent of the questionnaire, the arrival and departure rates and the duration of the survey. A preliminary pilot survey may be desirable to establish the practicality of that number.

4.4.9.3 Every parking incident within the study area should be recorded in pre-selected time intervals. Each interviewer should attempt to interview as many parkers as determined by the calculated size of sample.

4.4.9.4 The questions asked in the interview may be similar to those in section 4.4.7.7. Interviews on departure are preferred for the reasons given in section 4.4.7.8.

4.4.9.5 Normal sampling procedures should be used in selecting the interviewees, to avoid introducing bias into the analysis. Sampling could be carried out by selecting the driver of say every third parking vehicle, or other predetermined number. The selection should not be left to the discretion of the interviewer.

4.4.9.6 An alternative method would be to insert reply paid questionnaires under the windscreen wiper on all parked vehicles. Personnel costs for this method are smaller than for a personal interview since one person can cover a larger number of parked vehicles.

4.4.9.7 Information on the parking location and arrival time of the vehicle should be marked or precoded on the questionnaire as observed. That information should be recorded in a log book maintained by the person distributing the questionnaires to enable a method of control in the analysis of the replies received.

4.4.9.8 A disadvantage of this method of survey is the lack of control over the quality and quantity of information received in response to the questionnaires distributed.

4.4.9.9 The above surveys do not measure the latent demand for parking as many people wishing to visit the area may be turned away by the lack of parking facilities.

4.4.9.10 The best indication of latent demand could be obtained from a home interview survey. However, the large cost associated with a home interview survey is normally not justified on parking alone. Hence, questions on parking are grouped with other questions on a large transport questionnaire associated with a transport modelling methodology for estimating future travel and parking demand.

4.4.9.11 The questionnaire for an interview survey would need to be designed according to the specific objectives of the survey. The questions included in the questionnaire should be formulated to draw clear and precise answers in the shortest time.

4.4.9.12 More detailed guidance on survey design principles is provided in Chapter 1, and guidance on home interview Survey in Chapter 6 of this Volume.

TPDM Volume 8 Chapter 5 – Public Transport Surveys

5.1 General

5.1.1 Objectives of Public Transport Surveys

The objectives of public transport surveys are mainly:

(i) to collect data about the supply and demand of public transport services for planning and problem-solving purposes;

(ii) to monitor the franchised and licensed operators' compliance with the various requirements as laid down in the legislation; and

(iii) to obtain feedback from passengers on adequacy, quality and other aspects of public transport service provision.

5.1.2 Types of Transport Surveys

Based on the functions of the public transport surveys, they can be categorised into two main types:

(i) Study surveys: This type of surveys is to collect data on the demand of transport services for future enhancements, including the passengers' travelling patterns, their preference of transport modes and feedback on bus facilities. The results are useful for formulating long-term development strategies on public transport services.

(ii) Monitoring surveys: The surveys are aiming at monitoring the routine operation and performance of the franchised and licensed operators, their compliance with the scheduled requirements in providing the services. In addition, the information in respects of the adequacy, reliability and quality for provision of public transport services will also be collected. These surveys would also provide useful evidence for monitoring on both authorized and unauthorized non-franchised bus operation.

5.2 Franchised Bus Survey

5.2.1 Introduction

Information about the level of bus services can be obtained from the regular returns submitted by the bus operators as well as through surveys. Some of these surveys are regular checks (such as screenline surveys) whilst others are 'ad hoc' checks arranged mainly in response to complaints, suggestions or problems which have been identified from the regular returns submitted by the bus companies. These surveys largely include :

(a) Screenline surveys;

(b) Passenger waiting time surveys;

(c) Bus journey time surveys;

(d) Occupancy surveys;

(e) Origin and destination surveys; and

(f) Boarding and alighting surveys.

Apart from the above, it is a standard practice to conduct an inaugural surveys for each newly introduced route. The purpose of the survey is to ascertain the performance of the route and to propose changes if necessary. The survey is, in fact, a combination of surveys and the survey findings should cover vehicle allocation, adherence to schedule, journey time, layover time, passenger volume, travel pattern as well as adequacy of service.

5.2.2 Bus Allocation/Fleet Utilization Survey (Screenline Survey)

(i) Objective: To measure the reliability of existing services and to monitor the franchised operators' compliance with their schedules of services.

(ii) Design:

(a) Timing and Duration:
The survey should be conducted periodically, normally once a year but the frequency can be adjusted depending on the need and availability of manpower resources. The date of survey should be kept in confidence so as to maintain an element of surprise and in no way should the franchised operator be consulted prior to the survey day in order to avoid giving an opportunity to the operator to respond by fielding an appropriate number of buses especially for the occasion. surveys for operators on Hong Kong Island, Kowloon and New Territories i.e. NWFB, Citybus, KMB, and Long Win should be conducted on weekdays covering both/either the morning peak (between 7:00 a.m. and 10:00 a.m.) and/or evening peak (between 4:00 p.m. and 7:00 p.m.) periods when the greatest number of buses are expected on the roads. The survey for NLB buses should be conducted on a weekday and a Sunday or a public holiday during the period from 8:00 a.m. to 12 noon. The surveys should be of sufficient duration to enable any given bus to pass a screenline location at least twice (unless it returns to the depot during the period).

(b) Selection of survey locations:
The screenline locations should be selected to cover all the bus routes provided by the operator under survey. A full list of bus routes to be surveyed should be compiled and for long distance routes such as cross harbour services and the New Territories - Urban

services, two check points should be chosen to ensure full coverage of the allocated vehicles. As the screenline survey on KMB requires considerable staff resources, it is desirable to minimize the number of survey locations to reduce the manpower involved.

(c) Deployment of survey staff:
The number of survey staff assigned to each check point depends on the number of bus routes to be observed and in certain cases, more than one survey staff will have to be deployed to one selected check point.

(d) Briefing:
It is important to brief all survey staff the exact location of the check point, the route number, origin and destination, and travelling direction of the bus routes under survey, the use of survey sheets and data to be collected. survey staff should be reminded of the need to keep the survey day in confidence.

(iii) Data Collection:
The survey staff should record down the fleet number and the route number of buses observed passing the selected checkpoints at a 15-minute interval. The sample survey sheet is shown in Table 5.2.1.

(iv) Data Analysis:
The data collected are analyzed broadly in the following manner:

(a) arrange the recorded bus fleet numbers and route numbers in proper order, eliminating those fleet numbers which are recorded more than once on the same bus route; and

(b) match the bus fleet numbers with the latest bus fleet list obtained from the operator. The operator should be approached for the fleet list after the survey day.

(v) Result Presentation:
The results should indicate:

(a) the number of each type of registered buses observed in operation and the percentage in use (Table 5.2.2)

(b) the total number of buses allocated to operate the bus network during a specific period of time in the survey day (Table 5.2.2)

(c) the utilization rate of the registered bus fleet of the operator (Table 5.2.2)

(d) the scheduled and observed vehicle allocation on each route; the number of buses allocated exclusively on one route as well as the number ofinterworkingbuses i.e. those allocated in joint operation on several bus routes should be shown separately (Table 5.2.3)

(e) the vehicle allocation by type on individual routes (Table 5.2.4) ; and

(f) comparison should be made with the results of the previous survey in order to indicate any changes (Table 5.2.5).

Table 5.2.1 (Sample)

Screenline Survey - Survey Form

Date & Day_____ Location & Direction_____

Surveyor_____ Weather_____

*Time Period	Route No.	Fleet No.	*Time Period	Route No.	Fleet No.

* At 15 minutes intervals

Table 5.2.2 (Sample)

Summary of KMB Screenline Survey on _____

Date & Day_____ Location & Direction_____

Surveyor_____ Weather_____

Vehicle Type	No. of Registered Buses (Position as at _____)	No. of Buses Operated.	% in use
Single Decker Mitsubishi (Air-cond.) Mitsubishi MP618 (Air-cond.) Dennis Falcon Coach (Air-cond.) Toyota Midibus (Air-cond.) Dennis Dart 9M (Air-cond.) Dennis Dart 10M (Air-cond.) Dennis Lance (Air-cond.) *Sub-total* **Double Decker** Daimler Fleetline Dennis Leyland Victory II Leyland Olympian 9.5M Dennis Dominator 9.5M M.C.W. 9.7M Mercedes Benz Leyland Olympian 12M Dennis Dragon 12M M.C.W. 12M Leyland Olympian 11M M.C.W. 11M Dennis Dragon 11M Dennis Dragon 11M (Air-cond.) Leyland Olympian 11M (Air-cond.) Dennis Dragon 10M (Air-cond.) Scania 11.5M (Air-cond.) *Sub-total* Total			

Table 5.2.3 (Sample)

Screenline Survey
A Summary of Scheduled and Observed Vehicle Allocation by Route

Date & Day____________________ Location & Direction____________________

Surveyor____________________ Weather____________________

Route No.	Vehicle Allocation according to the Schedule of Service	Observed (Exclusive) Vehicle Allocation	Observed Vehicle Allocation Shared with other routes			
			Total No. of Buses	Details : No. of buses (Route No.)		

Table 5.2.4 (Sample)

Screenline Survey
KMB Vehicle Allocation by Type and Route

Date & Day_____ Location & Direction_____

Surveyor_____ Weather_____

Type	Capacity	Route No.									
		41	41A	41M	61M#	61P#	42	42A	42C	42M	42M#
Single Decker											
Mitsubishi (Air.)	45	0(0)	0(0)	0(0)	0(0)	0(0)	0(0)	0(0)	0(0)	0(0)	0(0)
Mitsubishi MP618 (Air.)	73	0(0)	0(0)	0(0)	0(0)	0(0)	0(0)	0(0)	0(0)	0(0)	0(0)
Dennis Falcon Coach (Air.)	45	0(0)	0(0)	0(0)	0(0)	0(0)	0(0)	0(0)	0(0)	0(0)	0(0)
Toyota Midibus (Air.)	21-24	0(0)	0(0)	0(0)	0(0)	0(0)	0(0)	0(0)	0(0)	0(0)	0(0)
Dennis Dart 9M (Air.)	53	0(0)	0(0)	0(0)	0(0)	0(0)	0(0)	0(0)	0(0)	0(0)	0(0)
Dennis Dart 10M (Air.)	37-62	0(0)	0(0)	0(0)	0(0)	0(0)	0(0)	0(0)	0(0)	0(0)	0(0)
Dennis Lance (Air.)	61-78	0(0)	0(0)	0(0)	0(0)	0(0)	0(0)	0(0)	0(0)	0(0)	0(0)
Double Decker											
Daimler Fleetline	113-115	0(0)	0(0)	0(0)	0(0)	0(0)	0(0)	0(0)	0(0)	0(0)	0(0)
Dennis	104-115	4(0)	0(0)	0(0)	0(0)	0(0)	0(0)	0(0)	0(0)	0(0)	0(0)
Leyland Victory II	102-109	5(0)	0(0)	0(0)	0(0)	0(0)	0(0)	0(0)	5(0)	0(0)	0(0)
Leyland Olympian 9.5M	100-111	0(0)	0(0)	0(0)	0(0)	0(0)	0(0)	0(0)	0(0)	0(0)	0(0)
Dennis Dominator 9.5M	103	1(0)	0(0)	0(0)	0(0)	0(0)	0(0)	0(0)	0(0)	0(0)	0(0)
M.C.W. 9.7M	95-112	0(0)	0(0)	0(0)	0(0)	0(0)	0(0)	0(0)	0(0)	4(0)	0(0)
Mercedes-Benz	123	0(0)	0(0)	0(0)	0(0)	0(0)	0(0)	0(0)	0(0)	0(0)	0(0)
Leyland Olympian 12M	149-164	0(0)	0(0)	0(0)	0(0)	0(0)	5(0)	5(0)	0(0)	0(0)	0(0)
Dennis Dragon 12M	140-152	0(0)	0(0)	0(0)	0(0)	0(0)	6(0)	6(0)	1(0)	0(0)	0(0)
M.C.W. 12M	158	0(0)	0(0)	0(0)	0(0)	0(0)	0(0)	0(0)	0(0)	0(0)	0(0)
Layalnd Olympian 11M	142-150	0(0)	4(0)	1(0)	0(0)	0(0)	0(0)	2(0)	2(0)	0(0)	0(0)
M.C.W. 11M	142-150	0(0)	3(0)	7(0)	0(0)	0(0)	0(0)	0(0)	1(0)	0(0)	0(0)
Dennis Dragon 11M	141-151	0(0)	1(0)	1(0)	0(0)	0(0)	1(0)	5(0)	5(0)	0(0)	0(0)
Dennis Dragon 11M (Air.)	135-141	0(0)	0(0)	0(0)	0(3)	0(3)	0(0)	0(0)	0(0)	0(0)	2(0)
Leyland Olympian 11M (Air.)	132-138	0(0)	0(0)	0(0)	0(0)	0(0)	0(0)	0(0)	0(0)	0(0)	0(0)
Dennis Dragon 10M (Air.)	117	0(0)	0(0)	0(0)	0(0)	0(0)	0(0)	0(0)	0(0)	0(0)	0(0)
Scania 11.5M (Air.)	125	0(0)	0(0)	0(0)	0(0)	0(0)	0(0)	0(0)	0(0)	0(0)	0(0)
TOTAL		10(0)	8(0)	9(0)	0(3)	0(3)	12(0)	18(0)	14(0)	4(0)	2(0)

Notes :
Figures in the table above are quoted for reference only.
Figures in brackets refer to separate number of buses shared with other route(s).
Air-conditioned bus.

Table 5.2.5 (Sample)

Screenline Survey
Comparison of Survey Findings

Date & Day_____ Location & Direction_____

Surveyor_____ Weather_____

	Previous Survey on D1.M1.Y1	Present Survey on D2.M2.Y2	Comparison of Findings D1.M1.Y1/D2.M2.Y2
No. of Registered Buses Single Decker Double Decker Total			
No. of Buses in Operation Single Decker Double Decker Total			
Utilization Rate of Bus Fleet (%) Single Decker Double Decker Total			
No. of Bus Routes Urban N.T. Cross Harbour Coach/Air-con Total			
Vehicle Allocation Scheduled Observed Exclusive Interworking Total			

5.2.3 Passenger Waiting Time Survey

(i) Objective: To obtain information on bus passengers' average waiting time at bus stops and bus termini in order to assess the service level / reliability of bus services.

(ii) Design: Depending on the number of bus routes, stops, and termini to be surveyed and the availability of survey staff, one of the methods for data collection depicted below should be chosen. Stopwatch and tally counter will be required for conducting the survey.

(iii) Data Collection:
There are five different methods of data collection:

(a) Queue length method:
The method is suitable for use at stops where there is a formal queue, which is easily identifiable, and in most cases where queue-rails and bus regulator are present. A team of three observers are required and data is collected in respect of:

(1) the number of passengers boarding the bus and the number of passengers joining the queue at regular intervals, usually one minute, but the duration of intervals and the number of readings to be obtained will depend on the length of the queue and the number of passengers leaving the queue;

(2) the registration number and carrying capacity of the buses deployed on the bus route under observation; and

(3) the departure times of the buses at the bus stop or terminus.

A sample of the survey sheet is shown at Table 5.2.6.

(b) Card method:
This method is used where queues are difficult to define, due to presence of other queues or physical constraints, or passengers not queuing at all. This method is carried out by handing each of the passengers a card with the time of his and her arrival recorded. Where arriving passengers are heavy, only a sample of passengers may be selected, say one in two or one in three. If required, additional information on origin and destination can also be sought. The cards are then collected from the passengers when they board the bus, and the survey staff notes the bus departure time in the card. The waiting times of the passengers can be calculated from the arrival and departure times noted on the cards. Information regarding bus registration number, bus route, departure times, the number of passengers left behind on each bus departure should also be obtained.

Table 5.2.6 (Sample)

Passenger Waiting Time Survey - Queue Length Check (Survey Form)

Date & Day :_____ Weather :_____

Location :_____ Surveyor :_____

Route No. (SD/DD) :_____ Direction :_____

Time Begin	No. of Pax. Shifted to take other modes	Time End	No. Counted in Queue	No. Boarded Bus During Count	Total in Queue	Time Begin	No. of Pax. Shifted to take other modes	Time End	No. Counted in Queue	No. Boarded Bus During Count	Total in Queue

(c) Observation method:

This method is suitable for obtaining waiting times by routes at stops shared by several routes. It can also be used at locations where it would be difficult to collect cards from passengers boarding the bus or where there are difficulties in defining the queue length clearly.

The method involves:

(1) noting the arrival times of random passengers as they approach the queue, with a brief description of the passengers and their departure time as they board the bus; and

(2) noting the registration number, the route number, the waiting times by route and the total number of passengers boarding the bus, left behind on each departure and the number of passengers leaving the queue.

(d) Spot check method I:

This method is an alternative and simpler method in measuring waiting time for spot check purpose. The survey staff is required to take information about

(1) the bus registration number, fleet number; bus capacity and departure times;

(2) the number of passengers boarding the bus, left behind on each bus departure and the number of passengers leaving the queue; and

(3) the length of the queue measured at the beginning and end of the survey and as frequently as possible when no bus is waiting in the bus bay picking up passengers.

(e) Spot check method II:
This method is similar to spot check method I except that information on the queue length is not recorded.

(iv) Data Analysis:

(a) Queue length method:

(1) After each observation, the information concerning the number of passengers joining/leaving the queue is recorded in a survey sheet, a sample of which is shown in Table 5.2.7. Queue length at the end of each minute is then calculated using the following formula:

$q_t = q_t - 1 + a_t - b_t$

Where

qt = queue length (in persons) at the end of t min.
qt-1 = queue length (in persons) at the end of (t - 1) min.
at = number of passengers joining the queue within the 1-minute interval ending at t min.
bt = number of passengers leaving the queue within the 1-minute interval ending at t min.

(2) A sample of the analysis of survey results is shown in Table 5.2.8.

-- The number of passengers joining and leaving the queue in column (2) and (3) respectively can be obtained directly from the survey and so is the queue length check in column (5).

-- The queue length at the end of each minute in column (4) is calculated from columns (2) and (3) according to the formula:
$q_t = q_t - 1 + a_t - b_t$
A sample of the results is shown in Table 5.2.8 (Sample A).

-- The observed queue lengths in column (5) are then compared with those calculated in column (4).

-- However, there may be discrepancy which is caused by passengers joining or leaving the queue unnoticeable. If discrepancy is more than 10 passengers, the calculated queue length figures in column (4) should be adjusted as shown in Table 5.2.8 (Sample B).

(3) The data shown on Table 5.2.7 are then summarised at 1-minute interval on a form, a sample of which is shown at Table 5.2.9 showing:
a -- total no. of passengers joining the queue within the 15-minute duration ,
b -- total no. of passengers leaving the queue within the 15-minute duration , and

Table 5.2.7 (Sample)

Passenger Waiting Time Survey - Queue Length Check (Summary of Results)

Starting Time :_____ Date & Day (Weather) :_____

Location :_____ Surveyor :_____

Route No. (SD/DD) :_____ Direction :_____

Time Interval (min.) (1)	No. of Pass. Joining Queue (2)	No. of Pass. Leaving Queue (Boarding) (3)	Queue Length at end of each min. (Persons) (4)	Queue Length Check (5)	Time Interval (min.) (1)	No. of Pass. Joining Queue (2)	No. of Pass. Leaving Queue (Boarding) (3)	Queue Length at end of each min. (Persons) (4)	Queue Length Check (5)
Queue Length at Start **A**					Queue Length after 30 min. **D**				
1					31				
2					32				
3					33				
4					34				
5					35				
6					36				
7					37				
8					38				
9					39				
10					40				
11					41				
12					42				
13					43				
14					44				
15					45				
16					46				
17					47				
18					48				
19					49				
20					50				
21					51				
22					52				
23					53				
24					54				
25					55				
26					56				
27					57				
28					58				
29					59				
30					60				
Total	B	C	Check		Total	E	F	Check	
Unadjusted A + B - C					Unadjusted D + E - F				
Adjusted A + B_a - C_a					Adjusted D + E_a - F_a				

Checked by _____ Checked by _____

Table 5.2.8 (Sample)

Passenger Waiting Time Survey - Queue Length Check
(Sample Results)

Sample A

Date & Day (Weather) : _____
Route No.(SD/DD): _____
Location : _____
Direction : _____
Surveyor : _____

Time Interval (min.) (1)	No. of Passengers Joining Queue (2)	No. of Passengers Leaving Queue (Boarding) (3)	Queue Length at end of each min. (Persons) (4)	Queue Length Check (5)
Queue Length at Start			A 30	
1	10	5	35	
2	7	9	33	
3	6	-	39	
4	7	-	46	
5	10	-	56	51
6	12	-	68	
7	15	-	83	
8	10	-	93	
9	11	-	104	
10	12	-	116	109
11	13	-	129	
12	10	36	103	
13	11	38	76	
14	15	40	51	
15	-	5	46	10

Sample B (Queue length adjusted):

Date & Day (Weather) : _____
Route No.(SD/DD): _____
Location : _____
Direction : _____
Surveyor : _____

Time Interval (min.) (1)	No. of Passengers Joining Queue (2)	No. of Passengers Leaving Queue (Boarding) (3)	Queue Length at end of each min. (Persons) (4)	Queue Length Check (5)
Queue Length at Start			A 30	
1	10	5	35	
2	7	9	33	
3	6	-	39	
4	7	-	46	
5	10	-	56	51
6	12	-	68	
7	18	-	78	
8	8	-	86	
9	8	-	94	
10	7	-	101	109
11	8	-	109	
12	4	36	77	
13	6	38	45	-36
14	10	40	15	
15	-	5	10	10

Table 5.2.9 (Sample)

Passenger Waiting Time Survey
(Summary of Results)

Route No. (SD/DD) : _____

Location & Direction : _____

Day and Dates Surveyed (Weather) : _____

15-min Interval	Total Queue Length *(Q)*	Total No. of Passengers Joining Queue *(a)*	Total No. of Passengers Leaving Queue *(b)*	Average Waiting Time (minutes) $W = \frac{2Q}{a+b}$
0700 - 0715				
0715 - 0730				
0730 - 0745				
0745 - 0800				
0800 - 0815				
0815 - 0830				
0830 - 0845				
0845 - 0900				
0900 - 0915				
0915 - 0930				
0930 - 0945				
0945 - 1000				

Hourly Interval	*(Q)*	*(a)*	*(b)*	*W*
0700 - 0800				
0800 - 0900				
0900 - 1000				

3-Hour Interval	*(Q)*	*(a)*	*(b)*	*W*
0700 - 1000				

Q --
sum of all queue lengths at the end of each minute in the 15-minute duration.

Subsequently, by feeding the above information into the formula below, the average waiting time for each passenger can be deduced. Although the formula is a simplified one, it gives a good approximation of the average delay suffered by each person waiting in the queue.

$$W = \frac{Q}{\frac{1}{2}(a+b)} = \frac{2Q}{a+b}$$

W - average waiting time (min.)

(4) The above formula gives an approximation for average waiting time since it assumes that the passengers who are in the queue at the beginning and end of the period have similar average waiting times. It also works best when the total numbers of passengers entering and leaving the queue are similar. In addition, if the survey covers more than one hour, errors tend to balance out and the formula provides a reasonable estimate of the average waiting time.

(b) Card method:

(1) The data collected using this method include:
T1 -- the time when the passenger joins the queue ; and
T2 -- the time when the passenger boards the bus.
The passenger waiting time can be derived by:
Passenger Waiting Time (Min.) = T 2 - T 1
Standard deviation of the average waiting time observed should be calculated so as to indicate how reliable is the collected waiting time data.

(2) A sample of the analysis is shown at Table 5.2.10.

(c) Observation method:
The analysis is the same as that for the card method. A sample of analysis is shown at Table 5.2.11.

(d) Spot check method I:

(1) The data collected using this method include:
Q -- summation of the lengths of the passenger queue measured in the hour ;
N -- total number of queue length counts in the hour ; and
B -- total number of passengers leaving the queue in the hour .

(2) The average waiting time (min.) is calculated by:

$$\frac{Q}{N} \times \frac{1}{B} \times 60$$

(e) Spot check method II:
The average passenger waiting time (min) is calculated by:

$$\frac{(B+2L)}{2NB} * T$$

B - the total number of passengers boarding buses in the period
L - the cumulative total number of passengers left behind after each bus departure during the period
N - the number of bus departures during the period
T - the length of the survey period (for one hour T = 60)

(v) Result Presentation:
Depending on the method used, the results of the surveys should be presented in tables showing:

(a) the scheduled and observed number of bus departures;

(b) the number of passengers boarding; and those being left behind on each bus departure;

and

Table 5.2.10
Passenger Waiting Time Survey ---- Card Method (Survey Form)

Date & Day : _____ Location : _____

Surveyor : _____ Weather : _____

Route No. (SD/DD) : _____ Direction : _____

Time joining the queue (T_1) : _____

Time boarding the bus (T_2) : _____

Total waiting time (T_2 - T_1) :_____

Analysis (Example)

Time joining the queue (T_1)	*Time boarding the bus (T_2)*	*Total waiting time (T_2 - T_1)*
0701	0703	2
0702	0703	1
0703	0703	0
0704	0707	3
0705	0707	2

Remarks: (i) only 5 readings obtained i.e. n = 5

(ii) $\bar{x}$ = sample mean = 1.6 minutes

(iii) $S^{\bar{x}}$ = standard deviation of sample = $\sqrt{\frac{\sum(x-\bar{x})}{n-1}}$ = 1.14 mins

Table 5.2.11
Passenger Waiting Time Survey ---- Observation Method (Survey Form)

Date & Day : _____ Location : _____

Surveyor : _____ Weather : _____

Route No. (SD/DD) : _____ Direction : _____

Time joining the queue	Particulars	Time boarding the bus	Route No.
0701	Man wears white shirt	0703	2
0702	A fat lady	0703	a
0703	ABC school girl	0703	0

Remarks : The relevant data say for Route No. 15C will only be extracted when doing the analysis

(c) the average, minimum and maximum passenger waiting time.
The results should be presented on a half-hourly basis and by route where the bus routes of surveyed bus stops and termini are easily distinguished or otherwise they can be presented by groups of bus routes.

5.2.4 Journey Time Survey

(i) Objective: to measure the actual time spent on a bus journey from one point to another, usually from one terminus to another terminus with a view to identifying the problem areas and causes of

delay.

(ii) Design: Depending on the number of bus routes to be surveyed and the availability of survey staff, one of the three methods for data collection depicted below should be chosen. The survey period, peak or off-peak should be decided according to the prevailing requirements. Stopwatch will be required for conducting the survey.

(iii) Data Collection: There are three methods of data collection.

(a) Terminal-check method:
This method is usually used for checking the journey time as required under the schedule of service. The survey staff are to be stationed at both terminal points of the bus route in question (one terminal point in the case of a circular bus route) to record down the bus registration or fleet number as well as the arrival and departure times (Table 5.2.12).

(b) On-vehicle method:
This method is more suitable to check bus journey times operating along certain major road corridors and to identify the problem areas. survey staff are deployed to board on a number of sample buses. The size of the sample will depend on the availability of manpower resources and the degree of precision; normally four to six sample rides on each bus route to be surveyed will be required. The following data should be collected (Table 5.2.13):

(1) The bus route number and the bus registration number.

(2) The arrival and departure times at the termini.

(3) The stopping times at each bus stop, traffic light, pedestrian crossing, road junctions. A list of bus stops, and traffic lights etc. should be compiled.

(4) The stopping times caused by congestion or other obstruction on the journey with details on the location and observed cause of obstruction.

For accuracy, the journey time should be measured by the difference of departure and arrival times recorded.

(c) Screenline check method:
Screenline can be set up along critical sections of bus route to record time and registration number of buses passing the screenlines. This method may be less manpower consuming than the on-vehicle method.

(iv) Data Analysis:

(a) Terminal-check method:

(1) The arrival times of the buses recorded at one terminal point are checked with the departure times recorded for the same buses. The journey time can then be calculated for each bus trip.

(2) The average journey speed can be calculated by the following formula

$$km/hour = \frac{Journey\ Distance\ (km)}{Total\ journey\ time\ (minutes)} * 60$$

(3) The analysed data can be summarised as in Table 5.2.14.

(b) On-vehicle method:

(1) The total journey times for a bus journey is calculated by checking the difference of departure and arrival times recorded.

(2) The total stopping times at traffic lights, bus stops, and road junctions are calculated including the total delayed time recorded.

(3) The average actual journey speed is calculated by

$$km/hour = \frac{Journey\ Distance\ (km)}{Total\ journey\ time\ (minutes)} * 60$$

(4) The average normal journey speed is calculated by

$$km/hour = \frac{Journey\ Distance\ (km)}{Total\ journey\ time\ (minutes)\ less\ total\ delayed\ time} * 60$$

(c) On-vehicle method:

(1) The journey time through route section can then be derived by matching the registration numbers of the buses.

(2) The average journey speed can be calculated by the following formula

$$km/hour = \frac{Journey\ Distance\ (km)}{Total\ journey\ time\ (minutes)} * 60$$

Table 5.2.12 (Sample)

Bus Journey Time Survey - Terminal Check Method (Survey Form)

Route No. (SD/DD) : _____

Bus Terminus & Direction : _____

Date & Day : _____ Time : _____

Surveyor : _____ Weather : _____

Bus Reg. No./ Fleet No.	Terminus :		Terminus *:	Calculated Journey Time (c) - (b)	Remarks
	Arrival Time (a)	Departure Time (b)	Arrival Time (c)		

Note:
* denotes the terminus at the opposite bound of the journey. The arrival time of the bus at the opposite bound terminus is recorded by another surveyor at that terminus.

Table 5.2.13 (Sample)

Bus Journey Time Survey - On-vehicle Method (Survey Form)

Route No. (SD/DD) : _____ Surveyor : _____

Bus Registration No. : _____ Departure from : _____

Weather : _____ Departure Time : (Scheduled) _____

Date & Day : _____ (Actual) _____

Location (Bus Stop/ Traffic Light/ Zebra Crossing)	(a) Travelling/Stopping Time		(b) Delayed Time		(c) Calculated Time (min/sec)			
	Arrival hr/min/sec	Departure hr/min/sec	Duration min/sec	Cause of Delay	Travelling	Stopping	Delay	Total

Table 5.2.14 (Sample)

Bus Journey Time Survey Terminal Check Method (Summary of Results)

Route No. (SD/DD) : _____ Date & Day : _____

Location : _____ Direction : _____

Journey Distance : _____

Scheduled Journey Time : _____ Average Journey Speed : _____

Period	Surveyed Journey Time (min/sec)			Surveyed Journey Speed (km/h)		
	Minimum	Maximum	Average	Minimum	Maximum	Average

(v) Result Presentation:
Results should indicate:

(a) the survey period on hourly basis, differentiate between peak and off-peak periods ;

(b) the journey times, journey speed in both inward and outward journeys ;

(c) the stopping times at bus stops, traffic lights and road junctions ;

(d) the delayed time, location and cause of delay ; and

(e) the percentage of stopping time and delayed time in terms of the total journey time.

A sample is shown at Table 5.2.15.

Table 5.2.15

Bus Journey Time Survey - Sample of Results

Survey Period : 7.00 - 9.00 a.m. Surveyor : _____ Location & Direction : _____

Day, and Date : 12.10.99 (Wed) Weather : _____

Route No. (SD/ DD)	Direction	Journey distance		(a) Total Journey Time (min/sec)		(b) Stopping Time at Bus Stops, Traffic Lights and Zebra Crossings (min/sec)								(c) Delayed Time (min/sec)				Stopping & Delayed (b)+(c) (min/sec)		Actual Running Time (a)-(b)-(c) (min/sec)
						Bus Stops				Traffic Light and Zebra Crossing				at Section No.	Cause	Total Time	%	Total	%	
		Scheduled	Surveyed	Scheduled	Surveyed	Total No.	Stopped	Total Time	%	Total No.	Stopped	Total Time	%							
68 (DD)	From Yuen Long (East) to Jordan Road Ferry	41.4 km	41.7 km	87	84'2"	48	32	7'34"	9	43	21	9'2"	11	5	Traffic Congestion	0'10"	0.2	16'46"	20	67'16"
	From Jordan Road Ferry to Yuen Long (East)	41.4 km	41.7 km	87	80'22"	47	31	6'52"	9	42	22	8'42"	11					15'34"	19.4	64'48"
68M (DD)	From Yuen Long (West) to Tsuen Wan MTR Station	28 km	27.5 km	53	40'52"	22	11	2'6"	9	9	6	1'51"	4.5	4	Traffic Congestion	0'17"	0.7	4'14"	10.4	36'38"
	From Tsuen Wan MTR Station to Yuen Long (West)	28 km	27.5 km	53	45'40"	21	13	3'14"	9	10	6	2'26"	5.3	3	Traffic Accident	0'28"	1	6'8"	13.4	39'32"

5.2.5 Occupancy Survey

(i) Objective: to examine the level of service including vehicle allocation adherence to schedule, passengers picked up/set down/ left behind, and bus occupancy at check points like termini, en-route bus stops or screenlines.

(ii) Design:

(a) Timing and duration:
The surveys can be undertaken during the peaks or off peaks, to check if the service level of the routes concerned is provided at the right level.

(b) Selection of locations:
The surveys should be carried out either at termini or the maximum loading points like screenlines or bus stops which have been identified from previous surveys, direct observation or other sources of information like complaints etc.

(iii) Data Collection:
The survey staff are to be stationed at the check points to record down the bus registration or fleet number, the licensed bus capacity, the observed bus arrival and departure time and an estimate of the loading conditions on arrival and departure. If the survey is conducted at termini, the loading condition of a bus can be observed by simply counting the number of boarding passengers. The information is entered onto the survey form shown in Table 5.2.16. In estimating the loading condition on buses, it is only necessary to estimate the number of standees on board the bus when it departs on assumption that passengers would stand if all the seats are filled up. If no standee is seen, the survey staff need to judge the loading condition by their experience.

(iv) Survey Analysis:
The occupancy (%) can be derived by:

$$Occupation(\%) = \frac{No.\,of\ passengers\ on\ board}{Bus\ carrying\ capacity}$$

(v) Result Presentation:
The results of the survey should indicate:

(a) the survey period on half-hourly or hourly basis;

(b) the scheduled and observed bus departures;

(c) the average headway;

(d) the carrying capacity;

(e) the number of passengers on board; and

(f) the occupancy.

A sample of the summary is shown in Table 5.2.17.

Table 5.2.16

Occupancy Survey of KMB Service

Date & Day : _____ Period : _____

Location : _____ Direction : _____

Surveyor : _____ Weather : _____

Route No. (SD/DD)				Route No. (SD/DD)				Route No. (SD/DD)				Route No. (SD/DD)			
Time	Ft/Reg No.	Cap	Occup	Time	Ft/Reg No.	Cap	Occup	Time	Ft/Reg No.	Cap	Occup	Time	Ft/Reg No.	Cap	Occup
Route No. (SD/DD)				Route No. (SD/DD)				Route No. (SD/DD)				Route No. (SD/DD)			
Time	Ft/Reg No.	Cap	Occup	Time	Ft/Reg No.	Cap	Occup	Time	Ft/Reg No.	Cap	Occup	Time	Ft/Reg No.	Cap	Occup
Route No. (SD/DD)				Route No. (SD/DD)				Route No. (SD/DD)				Route No. (SD/DD)			
Time	Ft/Reg No.	Cap	Occup	Time	Ft/Reg No.	Cap	Occup	Time	Ft/Reg No.	Cap	Occup	Time	Ft/Reg No.	Cap	Occup

Table 5.2.17

Summary of Screenline - Occupancy Survey on KMB/LW/NWFB/CTB(F1)/NLB/CTB(F2) Service

Date & Day _____ Location & Direction _____

Surveyor _____ Weather _____

Route No.	Period	Location & Direction	Vehicle Allocation (DD)			No. of Trips			Capacity	Passengers on Board	
			Sch.	Obs.	Diff.	Sch.	Obs.	Diff.		No.	%

5.2.6 Origin and Destination Survey

(i) Objective: to find out the origin and destination as well as the travel preferences of bus passengers so as to facilitate the planning of new bus services, re-routeing, truncation and extension of services as well as bus redeployment.

(ii) Design:

(a) Time and Duration:
The surveys are undertaken during both peak and off peak hours on weekdays, Sundays or Public Holidays.

(b) Selection of Locations:
The surveys should be carried out either at termini or the maximum boarding/alighting points which are identified from previous surveys or direct observation. However, when selecting the survey location, bus stops serving a number of routes and/or without proper queuing arrangement should be avoided.

(iii) Data Collection:
The survey staff are to be stationed to the survey spots to carry out interviews. The number of survey staff to be deployed depends on the passenger volume as well as the sample size (normally 1 in 3). Normally, three survey staff are required to carry out a small scale interview survey like for one single bus route. One staff should start at the beginning of the queue and work towards the end whereas another staff should at the same time start at the end of the queue and work towards the front. The purpose of the arrangement is to avoid duplication of interviews. The third survey staff is positioned at the head of the queue to record the following information:

(a) the fleet number of each bus arriving;

(b) the number of passengers leaving the queue to board the bus; and

(c) the departure time of the bus

When not involved in any of the above tasks, the third survey staff can assist in interviewing passengers in the queue. On lightly loaded or less frequent services, it is possible to carry out the survey with only two survey staff.

The information collected is recorded on a special pre-set questionnaire. Apart from the answers, the survey staff is required to record the time on the questionnaire at 15-minute interval. Depending on the information to be collected, the layout of the questionnaire should be designed as simple as possible. A sample of the questionnaire is shown in Table 5.2.18.

(iv) Data Analysis:

The sample size of passengers interviewed is calculated at hourly interval based on the number of passengers interviewed and the total number of passengers leaving the queue to board buses. Depending on the purpose of the survey, the results are analysed by grouping the passengers of same characteristics in respect of their transport need. The results are factored up based on the sample size to show the overall situation.

Table 5.2.18

Origin and Destination Survey - Sample Questionnaire

問卷

Questionnaires

Origin and Destination Survey for a XHT bus route from Yuen Long to Hong Kong Island.

由元朗至港島的隧巴服務之起點及終點調查。

1. Origin of this journey 出發地點：
   a. Home 家 □ Workplace 工作處 □ School 學校 □
   □ Other 其他 _____ (please specify 請註明)
   b. Tuen Mun District 屯門 □)
   Yuen Long District 元朗 □)
   □ Other 其他 _____)
   (please specify 請註明)

   _____
   (Name of Estate/Office/School/Street)
   屋邨/辦公室/學校/街道名稱

2. Destination of this journey 目的地：
   a. Home 家 □ Workplace 工作處 □ School 學校 □
   □ Other 其他 _____ (please specify 請註明)
   b. Central District 中環 □)
   Western District 西區 □)
   Wan Chai District 灣仔 □)
   Eastern District 東區 □)
   Southern District 南區 □)
   Kowloon 九龍 □)
   New Territories 新界 □)

   _____
   (Name of Estate/Office/School/Street)
   屋邨/辦公室/學校/街道名稱

3. Purpose of this journey 今次乘車目的：
   a. To/from work 上班/下班 □)
   b. To/from school 上學/放學 □)
   c. Social 社交活動 □)
   e.g. visit friends/relatives
   如探訪親朋
   d. Recreational 消遣娛樂 □)
   e.g. shopping, picnic 如購物、旅行
   e. □ Other 其他 _____)
   (please specify _____)
   請註明

4. Frequency of using this bus service 使用此項服務的次數：
   _____ times a week 每週次數

(v) Result Presentation:
The results should indicate:

(a) the hourly passenger volume leaving the queue to board buses and the number of passengers interviewed;

(b) the sample size of the survey; and

(c) the characteristics of passengers' transport needs.

5.2.7 Boarding and Alighting Survey

(i) Objective: to examine the passenger demand and level of service of along the bus route, including the number of passengers picked up and set down; and the occupancy at each of the bus stops.

(ii) Design:

(a) Time and Duration:
The surveys can be undertaken during the peaks or off-peaks, to check if the service level of the routes is provided at the right level.

(b) Selection of Locations:
The survey should be started from one of the terminating points to another, either to be carried out for one bound or both bounds.

(iii) Data Collection:
The survey staff are to be stationed on board to record down the bus registration or fleet number, the licensed bus capacity, the number of passengers boarding and alighting at each of the bus stops along the route. The information collected should be recorded on the survey form shown in Table 5.2.19.

(iv) Survey Analysis:
The occupancy (%) at each of the bus stops can be derived by:

$$Occupation(\%) = \frac{No.\,of\ passengers\ on\ board}{Bus\ carrying\ capacity}$$

(v) Result Presentation:

(a) the survey period;

(b) bus registration or fleet number;

(c) the direction of traveling;

(d) the carrying capacity;

(e) the list of bus stop designed along the bus route;

(f) the number of passengers picking up/setting down at each of the bus stops along the bus route;

(g) the number of passengers on board at each of the bus stops along the bus route; and

(h) the occupancy at each of the bus stops along the bus route.

Table 5.2.19

Boarding and Alighting Survey of Bus Service

Date & Day : _____ Period : _____

Location : _____ Direction : _____

Surveyor : _____ Weather : _____

Route No. : _____ Carrying Capacity : _____

Bus registration/fleet number : _____

Bus stop	No. of passengers picked up	No. of passengers set down	No. of passengers on board upon departure	Occupancy
1.				
2.				
3.				
4.				
5.				
6.				
7.				
8.				
9.				
10.				
11.				
12.				
13.				
14.				
15.				
16.				
17.				
18.				
19.				
20.				
21.				
22.				

5.2.8 Surveys on Bus Facilities and Passenger Feedback

Apart from conducting surveys to assess the level of franchised bus services, surveys on bus facilities, passenger feedback and categories of passengers are also conducted to monitor franchised bus services. Surveys are conducted in the following aspects:

(a) TV broadcasting system (also known as Multi-Media On Board (MMOB)) installed on buses surveys;

(b) Bus engine type surveys;

(c) Bus ramp surveys;

(d) Passenger satisfaction surveys; and

(e) Elderly concession fare scheme surveys.

5.2.8.1 TV Broadcasting System (MMOB) Survey

(i) Objective: to check whether the agreed arrangements for TV broadcasting services on franchised buses are properly implemented.

(ii) Design:

(a) Time and duration:
The surveys are recommended to be conducted during the non-peak hours in order to avoid delay of normal bus services.

(b) Selection of locations:
The surveys may be conduction in bus termini or bus depots.

(c) Equipment: Sound Level Meter

(iii) Data Collection:
With assistance from bus regulators at bus termini/bus depots, the survey staff have to measure noise level of TV broadcasting on both lower and upper decks without passengers on board. They also have to check whether only one speaker is activated for TV broadcasting and properly located on the lower deck; the quiet zone signs/notices are suitably posted; and the bus stop announcement systems work properly. The information collected should be recorded on the survey form shown in Table 5.2.20.

(iv) Survey Analysis:
The noise level of TV broadcasting is derived by:
Noise level with engine turned on and TV system turned on - Noise level with engine turned on but TV system turned off

(v) Result Presentation:

(a) date and time;

(b) location of survey;

(c) name of bus company;

(d) route number;

(e) bus registration;

(f) number and location of speaker activated for TV broadcasting on lower deck;

(g) posting of quiet zone stickers/labels;

(h) noise level for TV broadcasting on lower deck;

(i) noise level for TV broadcasting on upper deck; and

(j) performance of bus stop announcement.

Table 5.2.20
TV Broadcasting System on Buses - Survey Form

Date : _____
Location : _____

Time	Bus Co.	Route No.	Bus Reg. No.	Lower deck					Upper deck			Bus stop announcement system works properly [Y/N]
				Only one speaker activated on lower deck for TV broadcasting and properly located. [Y/N]	Posting of quiet zone stickers properly [Y/N]	Noise level under the speaker for TV broadcasting			Noise level at front portion			
						(a) With engine turned on & TV system turn on [dB(A)]	(b) With engine turned on & TV system turned off [dB(A)]	Difference (a) - (b) [dB(A)]	(c) With engine turned on & TV system turn on [dB(A)]	(d) With engine turned on & TV system turned off [dB(A)]	Difference (c) - (d) [dB(A)]	

Note : Noise level should be measured under the speaker activated for audio effect at lower deck and at the front portion of upper deck.

5.2.8.2 Bus Engine Type Survey

(i) Objective: to check the engine type of buses deployed by franchised bus companies on busy corridors in order to obtain the percentage of Euro II and above buses on these corridors.

(ii) Design:

(a) Time and duration:
The survey should be undertaken during peak hours when the franchised bus companies have tight schedule of vehicle allocation in order to depict the worst scenario.

(b) Selection of locations:
The survey should be conducted at a location or locations e.g. bus stop along the specific busy corridor where all franchised buses pass through. The survey can be carried out for one bound or both bounds.

(iii) Data Collection:
The survey staff is to be stationed at the location(s) as mentioned in (ii)(b) to record the route number and vehicle registration mark of the buses passing through. The information collected should be recorded on the survey form as shown in Table 5.2.21.

(iv) Study Analysis:
A full list of buses by Euro standards has already been obtained from each franchised bus company quarterly by Bus and Railway Branch. The lists will be used to verify the engine types of buses observed during the survey.

$$\% = \frac{No.of\ Euro\ II\ or\ above\ buses\ observed}{Total\ no.of\ buses\ observed}$$

(v) Result Presentation:

(a) Date and period of survey;

(b) Number of respondents;

(c) Vehicle registration marks of buses observed by bus companies and route numbers;

(d) Breakdown of buses observed by bus companies, bus routes and Euro standards (both the number of buses and percentage); and

(e) Breakdown of buses observed by Euro standards in total (both the number of buses and percentage).

Table 5.2.21

Bus Engine Type - Survey Form

Date of Survey : _____

Period of Survey : _____

Surveyor : _____

Direction : _____ Location : _____

Bus Company									
Route Number									
Vehicle Reg. No.									
Euro Type									
%									

5.2.8.3 Bus Ramp Survey

(i) Objective: to find out bus ramp users' preference over the features of ramp and their level of satisfaction towards the type and features of ramp, bus captain's assistance as well as ramp users' opinion on the interaction between them and other bus passengers.

(ii) Design:

(a) Target respondents
An access ramp is required for the wheelchair-bound passengers, passengers carrying heavy luggage or pushing a pram when boarding or alighting buses. To identify these types of passengers, the survey was designed to collect views through (i) sending questionnaires, (ii) conducting face-to-face interviews at bus terminus/stops (excluding passengers with physical disabilities), and (iii) focus group discussions.

(b) Timing and duration:
Part A of the Study is conducted by sending questionnaires to target group. Respondents were required to complete and return questionnaires within 2 weeks. Part B of the Study is a face-to-face interview conducted on a weekday and a Sunday during peaks and off-peaks at selected locations. Part C of the Study is focus group discussions. Two discussions are arranged on 2 Saturday afternoons.

(iii) Data Collection:

(a) For Part A of the Study, the surveyor sends questionnaires to disabled community through the assistance of Health, Welfare and Food Bureau. The surveyor consolidates the results when the questionnaires are returned;

(b) For Part B of the Study, the surveyors conduct face-to-face interviews at selected locations to collect views from bus ramp users (excluding passengers with physical disabilities); and

(c) For Part C of the Study, focus groups are arranged to collect detail views from bus ramp users.

(iv) Study Analysis:

(a) The % of passengers who are satisfied with various operational aspects in relation to bus ramp will be calculated; and

(b) Other opinion will also be listed in details.

(v) Result Presentation:

(a) Date and period of survey;

(b) Number of respondents;

(c) Satisfaction level of different groups of respondents on each operational aspect of bus access ramps;

(d) Preference of bus access ramps for each group of respondents;

(e) Views of respondents on bus captain's assistance;

(f) Views of respondents on their interaction with other bus passengers when using access ramps; and

(g) Other opinion collected.

5.2.8.4 Passenger Satisfaction Survey

(i) Objective: to collect views on the franchised bus operators' performance as perceived by passengers and to identify areas for future improvements.

(ii) Design:

(a) Target respondents
Regular passengers aged between 18 and 65 who take the franchised bus at least once a week are the targeted respondents of this survey.

(b) Survey method:
Opinions of passengers are collected by telephone interviews and obtained from a randomly selected household member who has used the franchised bus service at least once in the reference week.

(iii) Data Collection:
The surveyors are required to follow the questionnaire and collect information through telephone interviews.

(iv) Study Analysis:

(a) The % of passengers who are satisfied with various operational aspects of bus services will be calculated.

(b) The Passenger Satisfaction Index will be calculated to assess the passenger satisfaction level.

(v) Result Presentation:

(a) Date and time of survey;

(b) Number of respondents; and

(c) Evaluation of the results on various operational aspects of bus services provided by franchised bus operators.

5.2.8.5 Survey on Elderly Concession Fare Scheme (ECFS)

(i) Objective: to assess the proportion of franchised bus passengers paying elderly concessionary fare in order to examine the submissions for reimbursement of revenue forgone by the franchised bus companies under the ECFS.

(ii) Design:

(a) Timing and duration:
The survey should be undertaken from 7:00 a.m. to 12:00 midnight on a weekday, a Saturday and a Sunday for each of the selected routes.

(b) Selection of locations:
The survey should be started from one of the terminating points to another and vice versa.

(iii) Data Collection:
The survey staff will get on board the selected route(s) to record the number of passengers

picked up, the number of passengers paying elderly concessionary fares, the adopted paying method of the boarding passengers and the identification method of those paying elderly concessionary fare. The information collected should be recorded on the survey form as shown in Table 5.2.22.

(iv) Study Analysis:

The proportion (%) of elderly passengers of each franchised bus company can be derived from:

$$Proportion(\%) = \frac{\begin{matrix}5 * (no.of\ total\ elderly\ pax\ per\ weekday\ observed) \\ +1 * (no.of\ total\ elderly\ pax\ per\ Sat\ observed) \\ +1 * (no.of\ total\ elderly\ pax\ per\ Sun/PH\ observed)\end{matrix}}{\begin{matrix}5 * (no.of\ total\ pax\ per\ weekday\ observed) \\ +1 * (No.of\ total\ pax\ per\ Sat\ observed) \\ +1 * (No.of\ total\ pax\ per\ Sun/PH\ observed)\end{matrix}}$$

(v) Result Presentation:

(a) Date and time of survey;

(b) Franchised bus company and route number;

(c) Number of the surveyed trips;

(d) Number of boarding passengers, as well as passengers paying elderly concessionary fare;

(e) Number of passengers of each payment method and identification method used for checking eligibility;

(f) Proportion of passengers paying elderly concessionary fare paid by cash;

(g) Proportion of passengers paying elderly concessionary fare by Octopus; and

(h) Proportion of total passengers paying elderly concessionary fare.

Table 5.2.22
Elderly Concession Fare Scheme - Survey Form

Franchised Bus Company : _____

Route No. : _____

Origin/Destination of Route : _____

Survey Date : _____

Surveyor : _____

Time	No. of trips started[1]	No. of passengers boarded[2]						Method used to identify eligibility[3]			
		Total		Ordinary		Elderly		ID Card	SC Card	Verbal	Nil
		Cash	Octopus	Cash	Octopus	Cash	Octopus				
0700 – 0730											
0731 – 0800											
0801 – 0830											
0831 – 0900											
0901 – 0930											
0931 – 1000											
1001 – 1030											
1031 – 1100											
1101 – 1130											
1131 – 1200											
1201 – 1230											
1231 – 1300											
1301 – 1330											
1331 – 1400											
1401 – 1430											
1431 – 1500											
1501 – 1530											
1531 – 1600											
1601 – 1630											
1631 – 1700											
1701 – 1730											
1731 – 1800											
1801 – 1830											
1831 – 1900											
1901 – 1930											
1931 – 2000											
2001 – 2030											
2031 – 2100											
2101 – 2130											
2131 – 2200											
2201 – 2230											
2231 – 2300											
2301 – 2330											
2331 – 2400											

[1] Number of new trips started in the survey period; “0” if no new trips started

[2] excluding passengers who need not pay fare

[3] “ID Card: - showing I.D. Card; “SC Card” – showing Senior Citizens Card; “Verbal” – telling the driver that he/she

is eligible; and “Nil” – do not present the eligibility

5.3 Non-franchised Bus Survey

5.3.1 Introduction

Similar to franchised bus services, information about the level of some non-franchised bus (NFB) services, such as Residents' Services (RS), can be obtained from the regular returns submitted by the operators and through surveys. For other NFB services, such as Employees' Services (ES) and other coach and shuttle services, information about their service levels could be obtained by conducting surveys regularly or on an 'ad hoc' basis mainly in response to complaints, suggestions or problems identified from the regular returns submitted by the operators. These surveys largely include:

(a) Screenline surveys;

(b) Passenger waiting time surveys;

(c) Occupancy surveys; and

(d) Boarding and alighting surveys.

The arrangements for conduction of these surveys are similar to those for franchised bus services (please see sections 5.2.2, 5.2.3, 5.2.5 and 5.2.7). The survey forms are shown at Tables 5.3.1 to 5.3.11 for reference.

Also, it is a standard practice to conduct an inaugural survey for each newly introduced RS route. The purpose of the survey is to ascertain the performance of the route and to propose changes if necessary. The survey is, in fact, a combination of surveys on different aspects and the survey findings should cover vehicle registration number, PSL number, vehicle allocation, adherence to schedule, journey time, passenger volume, travel pattern, fare and method of payment, routeing, stopping places and adequacy of service.

Table 5.3.1 (Sample)
Screenline Survey on non-franchised bus service (RS/ES/coach/shuttle services)

Date & Day : _____ Location : _____

Time : _____ Direction : _____

Surveyor : _____ Weather : _____

Time	Route No. (if any)	Origin - Destination (if any)	Vehicle Registration No.	PSL number	Carrying Capacity	No. of pax. on board	Occupancy (5)

Table 5.3.2 (Sample)
Screenline Survey on non-franchised bus service (RS/ES/coach/shuttle services)
A Summary of Scheduled and Observed Vehicle Allocation by Route

Date & Day : _____ Weather : _____

Time : _____ Location : _____

Surveyor : _____ Direction : _____

Route No. (in ascending order)	Vehicle Allocation (according to the Schedule of Service)	Vehicle Allocation (observed)	Observed Vehicle Allocation Shared with other routes. If any			
			Total No. of vehicles	Details : No. of vehicles (Route No.)		

Total no. of vehicles observed : _____

Table 5.3.3 (Sample)

Passenger Waiting Time Survey on non-franchised bus service (RS/ES/coach/shuttle services)

Queue Length Check

Date & Day : _____ Weather : _____

Location : _____ Surveyor : _____

Route No. : _____ Direction : _____

Time Begin	No. of Pax. Shifted to take other modes	Time End	No. Counted in Queue	No. Boarded Bus During Count	Total in Queue	Time Begin	No. of Pax. Shifted to take other modes	Time End	No. Counted in Queue	No. Boarded Bus During Count	Total in Queue

Table 5.3.4 (Sample)

Passenger Waiting Time Survey on non-franchised bus service (RS/ES/coach/shuttle services)

Queue Length Check (Summary of Results)

Starting Time : _____ Date & Day (Weather) : _____

Location : _____ Surveyor : _____

Route No. : _____ Direction : _____

Time Interval (min.) (1)	No. of Pass. Joining Queue (2)	No. of Pass. Leaving Queue (Boarding) (3)	Queue Length at end of each min. (Persons) (4)	Queue Length Check (5)	Time Interval (min.) (1)	No. of Pass. Joining Queue (2)	No. of Pass. Leaving Queue (Boarding) (3)	Queue Length at end of each min. (Persons) (4)	Queue Length Check (5)
Queue Length at Start **A**					Queue Length after 30 min. **D**				
1					31				
2					32				
3					33				
4					34				
5					35				
6					36				
7					37				
8					38				
9					39				
10					40				
11					41				
12					42				
13					43				
14					44				
15					45				
16					46				
17					47				
18					48				
19					49				
20					50				
21					51				
22					52				
23					53				
24					54				
25					55				
26					56				
27					57				
28					58				
29					59				
30					60				
Total	B	C	Check		Total	E	F	Check	
Unadjusted A + B - C					Unadjusted D + E - F				
Adjusted A + B_a - C_a					Adjusted D + E_a - F_a				

Checked by _____ Checked by _____

Table 5.3.5 (Sample)

Passenger Waiting Time Survey on non-franchised bus service (RS/ES/coach/shuttle services)

Queue Length Check (Sample Results)

Sample A

Date & Day (Weather) : _____

Route No.(SD/DD): _____

Location : _____

Direction : _____

Surveyor : _____

Time Interval (min.) (1)	No. of Passengers Joining Queue (2)	No. of Passengers Leaving Queue (Boarding) (3)	Queue Length at end of each min. (Persons) (4)	Queue Length Check (5)
Queue Length at Start			A 30	
1	10	5	35	
2	7	9	33	
3	6	-	39	
4	7	-	46	
5	10	-	56	51
6	12	-	68	
7	15	-	83	
8	10	-	93	
9	11	-	104	
10	12	-	116	109
11	13	-	129	
12	10	36	103	
13	11	38	76	
14	15	40	51	
15	-	5	46	10

Sample B (Queue length adjusted)

Date & Day (Weather) : _____

Route No.(SD/DD): _____

Location : _____

Direction : _____

Surveyor : _____

Time Interval (min.) (1)	No. of Passengers Joining Queue (2)	No. of Passengers Leaving Queue (Boarding) (3)	Queue Length at end of each min. (Persons) (4)	Queue Length Check (5)
Queue Length at Start			A 30	
1	10	5	35	
2	7	9	33	
3	6	-	39	
4	7	-	46	
5	10	-	56	51
6	12	-	68	
7	18	-	78	
8	8	-	86	
9	8	-	94	
10	7	-	101	109
11	8	-	109	
12	4	36	77	
13	6	38	45	-36
14	10	40	15	
15	-	5	10	10

Table 5.3.6 (Sample)

Passenger Waiting Time Survey on non-franchised bus service (RS/ES/coach/shuttle services)

Summary of Results

Route No. : _____ Location & Direction : _____

Date and day: _____ Weather : _____

15-min Interval	Total Queue Length *(Q)*	Total No. of Passengers Joining Queue *(a)*	Total No. of Passengers Leaving Queue *(b)*	Average Waiting Time (minutes) $W = \frac{2Q}{a+b}$
0700 - 0715				
0715 - 0730				
0730 - 0745				
0745 - 0800				
0800 - 0815				
0815 - 0830				
0830 - 0845				
0845 - 0900				
0900 - 0915				
0915 - 0930				
0930 - 0945				
0945 - 1000				

Hourly Interval	*(Q)*	*(a)*	*(b)*	*W*
0700 - 0800				
0800 - 0900				
0900 - 1000				

3-Hour Interval	*(Q)*	*(a)*	*(b)*	*W*
0700 - 1000				

Q -- sum of all queue lengths at the end of each minute in the 15-minute duration.

Table 5.3.7 (Sample)
Passenger Waiting Time Survey on non-franchised bus service (RS/ES/coach/shuttle services)
Card Method

Date & Day : _____ Location : _____

Surveyor : _____ Weather : _____

Route No. (SD/DD) : _____ Direction : _____

Time joining the queue (T_1) : _____

Time boarding the vehicles (T_2) : _____

Total waiting time (T_2 - T_1) :_____

Analysis (Example)

Time joining the queue (T_1)	*Time boarding the bus (T_2)*	*Total waiting time (T_2 - T_1)*
0701	0703	2
0702	0703	1
0703	0703	0
0704	0707	3
0705	0707	2

Remarks: (i) (i) only 5 readings obtained i.e. n = 5

(ii) $\bar{x}$ = sample mean = 1.6 minutes

(iii) $S^{\bar{x}}$ = standard deviation of sample = $\sqrt{\frac{\sum(x-\bar{x})^2}{n-1}}$ = 1.14 mins

Table 5.3.8 (Sample)
Passenger Waiting Time Survey on non-franchised bus service (RS/ES/coach/shuttle services)
Observation Method (Survey Form)

Date & Day : _____ Location : _____

Surveyor : _____ Weather : _____

Route No. (SD/DD) : _____ Direction : _____

Time joining the queue	Particulars	Time boarding the bus	Route No.
0701	A man wears white shirt	0703	402R
0702	A tall man	0703	402R
0703	DEF schoolboy	0703	404R

Remarks : The relevant data say for RS Route No. 402R will only be extracted when doing the analysis

Table 5.3.9 (Sample)
Occupancy Survey of on non-franchised bus service (RS/ES/coach/shuttle services)

Date & Day : _____ Period : _____

Location : _____ Direction : _____

Surveyor : _____ Weather : _____

Route No. (SD/DD)				Route No. (SD/DD)				Route No. (SD/DD)				Route No. (SD/DD)			
Time	Ft/Reg No.	Cap	Occup	Time	Ft/Reg No.	Cap	Occup	Time	Ft/Reg No.	Cap	Occup	Time	Ft/Reg No.	Cap	Occup
Route No. (SD/DD)				Route No. (SD/DD)				Route No. (SD/DD)				Route No. (SD/DD)			
Time	Ft/Reg No.	Cap	Occup	Time	Ft/Reg No.	Cap	Occup	Time	Ft/Reg No.	Cap	Occup	Time	Ft/Reg No.	Cap	Occup
Route No. (SD/DD)				Route No. (SD/DD)				Route No. (SD/DD)				Route No. (SD/DD)			
Time	Ft/Reg No.	Cap	Occup	Time	Ft/Reg No.	Cap	Occup	Time	Ft/Reg No.	Cap	Occup	Time	Ft/Reg No.	Cap	Occup

TI : _____

Table 5.3.10 (Sample)
Summary of Screenline on non-franchised bus service (RS/ES/coach/shuttle services)
Occupancy Survey

Date & Day ______________________ Survey Period ______________________

Surveyor ______________________ Weather ______________________

Route No.	Period	Location & Direction	Vehicle Allocation (DD)			No. of Trips			Capacity			Passengers on Board	
			Sch.	Obs.	Diff.	Sch.	Obs.	Diff.	Sch.	Obs.	Diff.	No.	Occupancy (%)

5.3.2 Survey on Enforcement against Suspected Unauthorized NFB

NFB service plays a supplementary role and fills the market niches of the public transport system. NFB services are regulated by Passenger Service Licence ("PSL") issued under Road Traffic Ordinance, Cap. 374. Operation of NFB service is subject to PSL conditions. Different services permitted under the PSLs are represented by different service sub-type codes in PSL: -

(i) Objectives: to verify whether unauthorized service is provided by NFB and to collect operational details to facilitate further investigation and enforcement.

(ii) Licensing of NFB
The survey staff should possess basic knowledge of non-franchised bus licensing system. NFB is regulated by Passenger Service Licence ("PSL") issued under Road Traffic Ordinance, Cap. 374. Operation of NFB service is subject to PSL Conditions. Different services permitted under the PSLs are represented by different service sub-type code in PSL: -

Service sub-type code	Permitted service
A01	Tour
A02	Hotel
A03	Student
A04	Employees'
A05	International Passenger
A06	Residents'
A07	Multiple Transport
A08	Contract Hire

Specific conditions and display signs for Non-franchised Public Bus Service is at Appendix I. At present, the common types of unauthorized services were Residents' services without approval and unauthorized free bus service.

5.3.2.1 Residents' Service (Samples of the following information are provided at Appendix II for reference.
For every approved Residents' service, each bus should display:

(a) a yellow sign on the windscreen indicating the words RESIDENTS' SERVICE, the service's destinations and route number assigned by Transport Department;

(b) a copy of "Details of Approved Residents' Service" (認可居民巴士服務細則) (俗稱「灰證」) issued by Transport Department on the nearside front window of the bus; or the spare copy of "Details of Approved Residents' Service' (俗稱「橙證」) issued by Transport Department;

(c) a green Passenger Service Licence Certificate (客運營業證證明書) showing the route number approved by Transport Department at the left hand half of the windscreen; and

(d) a green disc showing the number of PSL at the rear of the vehicle.

5.3.2.2 Free Bus Service

Contract hire service is a type of service approved by the Commissioner under section 27(4)(b) of the Road Traffic Ordinance, Cap. 374. Under the existing PSL system, contract hire service is defined in Section A(1)(h) of the "NOTES TO HELP YOU" of the application form "APPLICATION FOR A PASSENGER SERVICE LICENCE - PUBLIC BUS SERVICE" (T.D. 246A) as: "For the carriage of passengers other than at separate fares - contract hire of buses to provide any services other than those in (a) to (g) above." Effectively it means any services other than those stipulated in section 4(3) of Public Bus Services Ordinance, Cap. 230 (i.e. Tour, Hotel, Student, Employees', International Passenger, Residents' and Multiple Transport Services) for the carriage of passengers not at separate fares.

Free bus service is a type of contract hire service. Currently it is defined in Condition 1 of the Passenger Service Licence Conditions for Public Bus as:

"Any service operated by buses specified in this licence or under the control of the same licensee, other than the types of public bus services specified in section 4(3) of the Public Bus Services Ordinance (Cap. 230), with a fixed route or fixed destination area and operated for more than 14 days either consecutively or intermittently during a continuous period of 12 months on which carriage is offered to any member of public, should be subject to the prior approval of the Commissioner for Transport in writing. An application to operate such a service, or to vary a service already approved, shall be delivered to the Commissioner not less than fourteen days prior to the date on which the applicant proposes it shall commence operation. The Commissioner may refuse the application or may specify the route, timetable, number and type of vehicles allocated and stopping places."

A copy of sample Passengers Service Licence Conditions is at Appendix III for reference.

(iii) Design

(a) Timing and duration:

From experience, unauthorized operations of residents' services were frequently found operating during the peak plying between residential developments and busy districts/location of workplaces.

As for unauthorized free bus service, they may operate in longer hours. Despite of this, survey on unauthorized free bus service normally does not require to cover whole operating period of the service. Observation of a few bus trips may already suffice to indicate the route has provided service on the survey date. However, it should note that when conducting surveys on unauthorized free bus service, it is normally required to conduct at least 15 surveys on separate dates within a period of 12 months to establish the fact that the licence holder has breached condition no. 1 of the PSL conditions.

The date of survey should be kept confidential and the operator/PSL holder should not be informed beforehand.

(b) Selection of locations:

The most common types of surveys are terminal check at the terminating points and on-board surveys on the vehicle. As the services may target designated group of people, the terminating point may be located within private housing estates and difficult to access by non-residents. Moreover, boarding passengers may be required to tender tickets/pre-paid coupons or to show membership card to verify identities.

If difficulty is encountered in accessing appropriate site for survey, it may consider using tailing survey by driving vehicle trailing the target vehicle to collect operational information.

(iv) Data Collection

A survey report is an important document to support the allegations against the unauthorized service. Details should be recorded as detailed as possible.

The survey staff should record down the bus registration number, PSL number, the licensed bus, details of the passenger service licence certificate, "Details of Approved Residents' Service" (灰證), spare copy of "Details of Approved Residents' Service" (橙證), time of departure/arrival, etc. A sample of the record sheet for a boarding and alighting survey is in Table 5.3.1

To prove the unauthorized non-franchised bus is providing a public bus service, it should establish that the service is charging separate fare to the passengers. The situation may be relatively simple if the driver receives cash payment himself/herself. However, it may be possible that someone else may handle the cash transaction and passengers may be required to tender pre-paid coupons in lieu of cash.

It is also important to remember face of the driver or any person solicits passengers for the service. This can make future identification work easier.

(v) Further investigation and enforcement

The observed service would be analyzed against the permitted services of the vehicle to see if there is any contravention.

The survey results may form part of the investigation and might be useful in enforcing the unauthorized bus activities. The Commissioner for Transport can appoint a public officer to hold an inquiry into the service pursuant to section 30 of Road Traffic Ordinance, Cap. 374. On the other hand, summons can be issued to defendant who has contravened the laws of Hong Kong. It should emphasize that whether evidence is sufficient to initiate enforcement should be assessed case by case. However, if it is prepared to use the survey results or rely on observation of the survey staff as part of the allegations against the service, the survey staff should be briefed beforehand that he/she might be called as witness to testify at court or as a public officer to give information in inquiry.

Table 5.3.11 (Sample)
Boarding and Alighting Survey of Unauthorized NFB Service

Date & Day : _____ Period : _____

Location : _____ Direction : _____

Surveyor : _____ Weather : _____

Route No. (if nay):_____ Carrying Capacity :_____

Bus registration mark : _____

Passenger service licence : _____

Service sub-types on the passenger service licence certificate: _____

Descriptions on display sign : _____

Information on "Details of Approved Residents' Service" (灰證)/ "Details of Approved Employees' Service", spare copy of "Details of Approved Residents' Service" (橙證) (if any)
_____

Bus stop	No. of passengers picked up	No. of passengers set down	No. of passengers on board upon departure	Occupancy
1.				
2.				
3.				
4.				
5.				
6.				
7.				
8.				
9.				
10.				

Other observations :
_____

5.3.3 Household and Self-administered Survey

Apart from conducting surveys on level of services and authorisation for operating non-franchised bus services, study on utilization of different types of non-franchised bus services can also be conducted to collect information on usage of non-franchised bus services by local residents and visitors and their trip characteristics. The study consists of:

(a) a household survey; and

(b) a self-administered mail survey.

As the study usually involves a complex survey planning, a large-scale fieldwork or interview and intensive project administration and monitoring which require a pool of professional and experienced survey staff to complete the study within a specific survey period, the study will usually be contracted out to market research or consultancy firms which have intensive experience and staff resources to undertake large-scale household and mail surveys.

5.3.3.1 Household survey

(i) Objective:
To study the utilization of non-franchised bus services by local residents in terms of number of trips made on a reference day, their trip characteristics such as type of service, time, trip purpose, fare and the main reason for choosing non-franchised bus over other modes of transport, and users' opinions in terms of satisfaction and plans for making non-franchised bus trips in future to facilitate the promulgation of policies in defining the role of non-franchised bus in the transport hierarchy and regulating the non-franchised bus services in the local transport market.

(ii) Design:
It shall be a telephone household survey using a random and representative sample of all households with telephones in Hong Kong. Interviewers will phone the selected households and collect the following information:

(a) All persons in each sampled household shall be asked on the following information (for household members who are below the age of 15 or are unable to provide the required information by reason of sickness or other sufficient cause, a knowledgeable person in the household shall be requested to provide the information for them):

(1) the number of non-franchised bus trips they made on a reference day;

(2) for each trip such details as type of service, time, trip purpose, fare and the main reason for choosing non-franchised bus over other modes of transport;

(3) anticipated changes in the use of non-franchised buses in the coming year; and

(4) basic demographic information, including items such as sex, age and industry.

(b) A member selected randomly among all members aged 15 and over in the household, who have used at least once non-franchised bus service in the reference week, will be asked on their level of satisfaction on non-franchised bus services in general and their opinions on specific topics related to operation of non-franchised buses.

(iii) Survey Planning:
Tasks include:

(a) preparing a detailed plan for the survey, including work programme and deployment of staff to the survey (in drawing up the work programme, consideration should be taken into public holidays and their implications on fieldwork);

(b) developing a design of the survey, including aspects (where appropriate) such as sample selection, estimation method to expand sample data to population, fieldwork procedures, fieldwork organization, progress reporting system and field control procedures;

(c) designing questionnaires in English and Chinese for the survey. A sample questionnaire is shown in Appendix IV for reference; and

(d) conducting a pilot of at least 30 cases for the survey to test the survey design and the questionnaire design. Questionnaire should be refined based upon the findings and problems identified during the pilot survey. The selected households in the pilot should not be counted in the main survey.

(iv) Fieldworks
Tasks include:

(a) selecting a random and representative sample of households with telephones and conduct interviews in a period of at least 2 weeks including Saturday and Sunday and within 7 weeks of the commencement of the survey;

(b) preparing a training and instructional manual for all interviewers;

(c) adequately training field supervisors and interviewers, particularly on their understanding of the contents of the questionnaires, before they are deployed to carry out the fieldwork;

(d) providing telephone hotline service for enquiry during the field operation period. The hotline(s) should be answered by designated staff between 10:00 am and 10:00 pm throughout the field operation period;

(e) collecting information from at least 3 000 households while achieving a response rate of at least 60%, which is calculated by dividing the number of successful household telephone interviews by the total number of eligible cases (refusal cases should be counted as eligible cases); and

(f) implementing quality check measures which shall include but not limited to the following for quality check purpose during and after the fieldwork, providing:

- a list of all telephone numbers selected for the telephone survey before the survey commences;
- the enumeration results of cases completed in each week within 5 working days after that week; and
- for each type of the following cases, a list of telephone numbers randomly selected from: (a) successfully enumerated cases; (b) non-contact cases; (c) refusal cases; and (d) non-eligible cases. The maximum number of cases to be selected for each type is 100.
- adopting appropriate measures to boost up response rate and to ensure that the survey results are not biased;

- checking at least 15% (both successful and unsuccessful cases) on a random basis by checkers who are not interviewers themselves;
- making at least 8 attempts to contact the households at different times (at least once in the evening) and on different days of the week before classifying a case as non-contact; and
- editing, coding and validating all completed survey forms to ensure completeness, accuracy, logic and consistency of the collected data.

(v) Data Analysis and Tabulation:
Tasks include:

(a) tabulation of data in accordance with the survey objectives, the management needs and the policy requirements and expansion of sample data to derive estimates for the whole population

(b) enumeration results of the survey and results of the quality checking; and

(c) comparing results with those of similar surveys conducted before and reconciliation with similar statistics available from other sources, such as the administrative records submitted by the non-franchised bus operators, and results of other studies on non-franchised buses.

5.3.3.2 Self-administered Mail Survey

(i) Objective:
To study the utilization of non-franchised bus services by visitors in terms of number of passenger journeys for visitors from the Chinese Mainland and oversea, their trip characteristics such as type of service, time and trip purpose, and visitors' opinions on non-franchised buses.

(ii) Design:
It shall be a self-administered mail survey (supplemented with follow-ups by telephone and field visit if necessary) covering all member companies of the Travel Industry Council providing in-bound tour services. The following information is to be collected from each company:

(a) number of passenger journeys for visitors from the Chinese Mainland and overseas they received on a reference day and the number of non-franchised bus trips made by these visitors under their arrangement;

(b) for each trip details such as type of service, time, trip purpose;

(c) anticipated changes in demand for non-franchised bus services by visitors in the coming year;

(d) basic background information of the company, including items such as employment size and major business; and

(e) Other opinions on the non-franchised bus services for visitors.

(iii) Survey Planning:
Tasks include:

(a) preparing a detailed plan for the survey, including work programme and deployment of staff to the survey;

(b) designing questionnaires in English and Chinese for the survey. A sample questionnaire is shown in Appendix V for reference; and

(c) consulting at least two companies providing in-bound tour services to ensure that survey design and questionnaire are both workable.

(iv) Process

Tasks include:

(a) preparing a training and instructional manual for all interviewers for follow-up with the companies;

(b) adequately training supervisors and interviewers, particularly on their understanding of the contents of the questionnaires, before they are deployed to carry out the follow-up with companies;

(c) providing telephone hotline service for enquiry during the survey period. The hotline(s) should be answered by designated staff between 10:00 a.m. and 10:00 p.m. throughout the survey period;

(d) collecting information from the companies while achieving a response rate of at least 60%, which is calculated by dividing the number of successful company interviews by the total number of eligible cases (refusal cases should be counted as eligible cases). If required, assistance should be provided to the companies in completing the questionnaire. For companies not responding to the mail questionnaire, follow-up by telephone calls and field visits should be conducted; and

(e) implementing quality check measures which shall include but not limited to the following:

- adopting appropriate measures to boost up response rate and to ensure that the survey results are not biased;
- checking at least 15% of cases in which the information is collected by interviewers on a random basis by checkers who are not interviewers themselves (in other words, checking of cases in which the companies return the questionnaire in the first instance is not required);
- making at least 3 contacts (including at least one field visit during office hours) to the companies which do not respond to survey; and
- editing, coding and validating all completed survey forms to ensure completeness, accuracy, logic and consistency of the collected data;

(v) Data Analysis and Tabulation:

Tasks include:

(a) tabulation of data in accordance with the survey objectives, the management needs and the policy requirements and expansion of sample data to derive estimates for the whole population;

(b) enumeration results of the survey and results of the quality checking; and

(c) comparing results with those of similar surveys conducted before and reconciliation with similar statistics available from other sources, such as the administrative records submitted by the non-franchised bus operators, and results of other studies on non-franchised buses.

5.4 Taxi Survey

5.4.1 Introduction

5.4.1.1 Two surveys are conducted on a regular basis to monitor the operation of the taxi trade:years.

(i) One survey deals with the measurement of the level of taxi service based on direct observation. This survey covers two separate parts on taxi stand survey and roadside observation survey respectively (see Section 5.4.2). The scope of the survey may also expand to cover assessment of the number of operative urban and NT taxis on a need basis while similar assessment for Lantau taxi will be conducted annually.

(ii) The other survey comprises a questionnaire survey, a meter reading survey and a sundry income survey covers the aspect of taxi utilization and operating finance (see Section 5.4.3).

5.4.1.2 In addition to these two surveys, Utilization of Taxi Stand survey is sometimes carried out to gather information on the utilization of specific taxi stands (see Section 5.4.4).

5.4.2 Survey on the Level of Taxi Service

5.4.2.1 Survey Objectives:

(i) The primary objective of the survey is to establish the overall level of taxi service at different locations in the Territory and at different times of the day by measuring a number of performance indicators. By comparing the results with those obtained in a previous period, changes in the level of taxi service can also be ascertained. The performance indicators adopted in the survey include:

(a) passenger waiting time at operative taxi stands;

(b) taxi waiting time at operative taxi stands;

(c) percentage of occupied taxis on Trunk roads, Primary Distributors and Rural Roads (A); and

(d) vacant taxi headway on Trunk Roads, Primary Distributors and Rural Roads (A).

(ii) Estimates of the above performance indicators are obtained through a two-part survey. The first part is a taxi stand survey for items (a) and (b) and the second part is a roadside observation survey for items (c) and (d).

5.4.2.2 Coverage and Sampling Frame:

(i) Taxi Stand Survey

(a) A list of all the taxi stands in the Territory together with their level of utilization is kept by Ferry and Paratransit Division. This frame will be updated regularly when there are new taxi stands that become operative or existing taxi stands become obsolete.

(b) As the estimates of passenger and taxi waiting time should be those pertaining to the operative taxi stands, those stands used mainly for parking purpose and thus with a very low utilization rate are excluded from the frame of taxi stands from

which samples of taxi stands are selected.

(ii) Roadside Observation Survey:

(a) To compromise between resources requirements and the survey objectives, the roadside observation survey is restricted to only part of the road network. The estimates obtained for the Urban Trunk Roads and Primary Distributors serve to indicate the level of taxi service in the urban area whilst those for the Rural Trunk Roads and Rural Roads (A) indicate the situation in the New Territories. Local Roads and District Distributors are not included as their special road traffic conditions, e.g. frequent congestion, may substantially distort the estimates on level of taxi service. Moreover, it is believed that the level of taxi service at these roads can be adequately represented by the other road types in the frame. Although there may be clearway restrictions on Trunk Roads and Primary Distributors, level of taxi service observed at these road types should reflect the level of taxi services at the other road types nearby.

(b) The frame for the roadside observation thus contains whole or part of the length of Trunk Roads and Primary Distributors in the urban area, and Trunk Roads and Rural Roads (A) in the New Territories. A list of roads by type and district in the Territory is kept by TTSD, which will be updated regularly.

5.4.2.3 Survey Design:

(i) Taxi Stand Survey

(a) A disproportionate stratified cluster sampling design is adopted for estimating the passenger and taxi waiting time at operative taxi stands. Stratified sampling refers to the categorization of the population of taxi stands into a number of groups called stratum within each of which a random sample of taxi stands is selected. Disproportionate refers to the fact that the sampling fractions for the strata differ. Each taxi stand is regarded as a cluster of passengers or taxis of unequal size with the passengers or taxis being the sampling elements.

(b) Area is categorized as Central and Western, Wan Chai and Eastern, Southern, East Kowloon, West and South Kowloon, Tsuen Wan and Kwai Chung, Sha Tin, Tuen Mun and Yuen Long, North New Territories and Sai Kung. Such usage classification is arbitrarily defined. Other usage classifi-cation may also be used, but precision of the estimates will not be substantially affected by the different classification schemes to be adopted.

(c) For each stratum, a number of taxi stands are then selected randomly. The number of taxi stands selected is significantly influenced by practical consideration and users' area of interest besides the consideration of the variability of the estimates. In the light of the experience obtained in each round of the survey, the classification of the taxi stands in the sampling frame and the number of taxi stands required for each stratum will have to be reviewed for the next round of survey.

(d) In the light of the experience obtained in each round of the survey, the classification of the taxi stands in the sampling frame and the number of taxi stands required for each stratum will have to be reviewed for the next round of survey. In addition, if there are new taxi stands to be added to the frame or obsolete taxi stands to be deleted from the frame, a supplementary sample or even a completely new sample will have to be drawn for the new round of the survey.

(e) The stratification scheme as shown in Table 5.4.2.1 has been adopted starting in the 2002 round of survey. The total number of taxi stands to be sampled is limited by resources constraint and can be further increased in case additional resources are available.

(ii) Roadside Observation Survey

(a) As in the case of the taxi stand survey, a disproportionate stratified cluster sampling design is adopted. Each road link is considered as a cluster and each taxi passing through or vacant taxi headway at the road link is the sampling element.

(b) The road links are stratified by area as in the case of the Taxi Stand survey.

(c) Besides consideration of the desired level of sampling errors, the number of sites selected for each of the strata is also governed by other practical considerations, e.g. the resources required and the need of results for individual sites by the users mainly for other applications.

(d) For each of the strata, the sites are selected using a systematic sampling approach with selection probability proportional to the length of the road link. This will ensure a reasonable geographical distribution of the road links selected and those long road links will have a higher probability of being selected.

(e) Details of the procedures for the selection of sites for the roadside observation survey using selection probability proportional to the length of the road link can be found in Appendix VI.

(f) The following stratification scheme (as shown in Table 5.4.2.2)as in the taxi stand survey has been adopted in 2000 round of survey.

Table 5.4.2.1
The Stratification Scheme for Taxi Stand Survey Adopted in 2002

	Urban Taxi			NT Taxi		
	Total No.	No. Sampled	Pro. of Selection	Total No.	No. Sampled	Pro. of Selection
Hong Kong Island						
Central & Western	17	7	0.41	-	-	-
Wanchai & Eastern	39	11	0.28	-	-	-
Southern	10	6	0.60	-	-	-
Kowloon						
East Kowloon	51	10	0.20	-	-	-
West and South Kowloon	37	9	0.24	-	-	-
Tsuen Wan & Kwai Chung	19	7	0.37	2	1	0.50
Sha Tin	32	13	0.41	13	6	0.46
New Territories						
Tuen Mun & Yuen Long	39	7	0.18	45	11	0.24
North New Territories	32	9	0.28	33	13	0.39
Sai Kung	18	6	0.33	7	4	0.57
Total	294	85		100	35	

Table 5.4.2.2
The Stratification Scheme for Roadside Observation Survey

Stratum		No. of Samples	
		Urban Taxis	NT Taxis
1.	Central & Western	8	
2.	Wanchai & Eastern	10	
3.	Southern	7	
4.	East Kowloon	10	
5.	West and South Kowloon	9	
6.	Tsuen Wan & Kwai Chung	9	5*
7.	Sha Tin	11	4*
8.	Tuen Mun & Yuen Long	7	7
9.	North New Territories	7	7
10.	Sai Kung	9	5*
Total		87	28

5.4.2.4 Data Collection:

(i) Taxi Stand Survey

(a) The field work usually takes place on weekdays between March and June, excluding school holidays at Chinese New Year and Easter.

(b) At each selected taxi stand, the arrival and departure times of all taxis and passengers are recorded at one minute interval during the period from 7:00 a.m. to 7:00 p.m. The times at which taxis or passengers slipped out of the queue are also recorded. To facilitate checking of the survey results, the queue lengths of taxis and passengers at various intervals are also recorded.

(c) A sample of the data collection form used is at Table 5.4.2.3.

(ii) Roadside Observation Survey

(a) The period for data collection is the same as that for the taxi stand survey.

(b) At the selected sites, observations are made during the time period from 7:00 a.m. to 7:00 p.m. The number of taxis not for hire, vacant taxis and the occupancy of each occupied taxi are recorded at one-minute intervals. To alleviate the burden of the field staff, each staff is charged with the responsibility of recording observations for up to two lanes only.

(c) Table 5.4.2.4 shows a sample of the data collection form.

Table 5.4.2.3
Collection Data
On Taxi / Passenger Waiting Time During Queuing

Location : _____ No. :_____ Observer : _____

Date : _____ Day :_____ Weather : _____

Time : From : _____ To : _____ Survey Period : 7:00 a.m. - 7:00 p.m

Taxi Stand Survey

Tax													**Passenger**			
Time Interval (min.)	No. of Taxi Joining Queue	No. of Taxi Leaving w/o Pass.	Occupancy in Occupied Taxi									Taxi Q Length	Time Interval (min.)	No. of Pass. Joining Queue	No. of Pass. Leaving Queue	Pass. Queue Length
1													1			
2													2			
3													3			
4													4			
5													5			
6													6			
7													7			
8													8			
9													9			
10													10			
11													11			
12													12			
13													13			
14													14			
15													15			
16													16			
17													17			
18													18			
19													19			
20													20			
21													21			
22													22			
23													23			
24													24			
25													25			
26													26			
27													27			
28													28			
29													29			
30													30			

Table 5.4.2.4
Sample Form For Roadside Location Count

Location : _____ No. :_____ Observer : _____

Date : _____ Day :_____ Weather : _____

Time : From : _____ To : _____ Survey Period : 7:00 a.m. - 7:00 p.m

Roadside Taxi Survey

Time Interval (min.)	No. of "Not for Hire" Taxis	No. of Vacant Taxis	Occupancy in each Occupied Taxi								Time Interval (min.)	No. of "Not for Hire" Taxis	No. of Vacant Taxis	Occupancy in each Occupied Taxi							
1											31										
2											32										
3											33										
4											34										
5											35										
6											36										
7											37										
8											38										
9											39										
10											40										
11											41										
12											42										
13											43										
14											44										
15											45										
16											46										
17											47										
18											48										
19											49										
20											50										
21											51										
22											52										
23											53										
24											54										
25											55										
26											56										
27											57										
28											58										
29											59										
30											60										

5.4.2.5 Estimation:

(i) Taxi Stand Survey
Basically, ratio estimators are used for estimating the population parameters. Details of the procedures for obtaining estimates for individual taxi stand and those pertaining to respective strata, area and the whole Territory can be found in Appendix VII.

(ii) Roadside Observation Survey
The estimation procedures for each site, stratum, area and the whole Territory are similar to those of the taxi stand survey. Details can be found in Appendix VIII.

5.4.2.6 Result Presentation:

(i) Taxi Stand Survey

(a) The results of the taxi stand observation are tabulated for each taxi stand to indicate the hourly variations of the following:

(i) number of passengers boarding and leaving queue;

(ii) maximum and average passenger queue length;

(iii) maximum and average passenger waiting time;

(iv) number of taxis departing with and without passengers;

(v) maximum and average queue length of taxis;

(vi) maximum and average waiting time of taxis; and

(vii) average number of passengers per taxi.

Moreover, estimates pertaining to a stratum, an area and the whole Territory are also derived. Samples of the results are given in Tables 5.4.2.5 and 5.4.2.6.

(b) Comparisons are also made with the preceding survey to reflect changes on individual site/stratum/area basis of the following:

(i) proportion of occupied taxis;

(ii) headway between vacant taxis;

(iii) average number of passengers boarding at taxi stands; and

(iv) passenger waiting time at taxi stands.

The use of t-test# can throw light on the significance of the difference between the results for the two periods. The difference of the estimates for the two periods is subject to two sources of variation, namely the random variation of the individual estimates due to sampling errors and the genuine difference between the means of the two periods. The test of significance will indicate whether or not the difference of the results for the two periods under study is mainly due to the source of random variation. A sample of the results is at Table 5.4.2.7.

(c) Besides estimates pertaining to the whole day as mentioned above, estimates for the hourly variations for the taxi stand survey and roadside observation survey are

also derived.
The results are presented in a sample at Table 5.4.2.8.

(ii) Roadside Observation Survey

(a) The results of the roadside observation are similarly tabulated for each observation point to show the following:
number and percentage of vacant, occupied and "not for hire" taxis;number of passengers per occupied taxi; andmaximum and average headway between vacant taxis.

(b) Similarly, estimates pertaining to a stratum, an area and the whole Territory are derived. Samples of the results are at Tables 5.4.2.9 and 5.4.2.10

Table 5.4.2.5
Example of Results of Survey for Queue Length and Waiting Time of Passengers and Taxis at Taxi Stand
RESULTS OF TAXI STAND SURVEY

RESULTS OF TAXI STAND SURVEY
QUEUE LENGTH AND WAITING TIME OF PASSENGERS AND TAXIS AT TAXI STAND

Code : SHC1

Location : Rumsey Street (outside Vicwood Plaza)

Area : Central and Western

Taxi Type : Urban

HOUR BEGINNING	PASSENGER						TAXI						AVERAGE NUMBER OF PASS PER TAXI
	BOARD-ING	LEAVING QUEUE	QUEUE LENGTH		WAITING TIME (MIN.)		TOTAL NUMBER DEPARTING		QUEUE LENGTH		WAITING TIME (MIN.)		
			MAX	AVE	MAX	AVE	WITH PASS.	W/O PASS.	MAX	AVE	MAX	AVE	
07:00	9	0	0	0.00	0	0.00	4	2	1	0.1	2	0.75	2.25
08:00	20	0	0	0.00	0	0.00	16	16	5	2.7	15	8.11	1.25
09:00	42	0	0	0.00	0	0.00	27	9	6	3.92	21	8.03	1.56
10:00	50	0	0	0.00	0	0.00	37	10	6	5.22	16	8.08	1.35
11:00	77	4	0	0.00	0	0.00	55	3	7	5.47	11	6.02	1.4
12:00	136	0	0	0.00	0	0.00	91	8	7	5.1	8	3.38	1.49
13:00	68	0	0	0.00	0	0.00	51	2	6	5.78	10	6.8	1.33
14:00	141	0	0	0.00	0	0.00	101	13	6	4.4	10	2.61	1.4
15:00	80	1	0	0.00	0	0.00	62	13	7	5.03	10	4.9	1.29
16:00	113	0	0	0.00	0	0.00	80	6	6	4.55	9	3.42	1.41
17:00	94	0	0	0.00	0	0.00	72	8	7	4.35	7	3.53	1.31
18:00	132	0	0	0.00	0	0.00	95	15	6	4.18	8	2.57	1.39
Total	**962**	**5**	**0**	**0.00**	**0**	**0.00**	**691**	**105**	**7**	**4.23**	**21**	**4.33**	**1.39**
(2001 Total)	(1150)	(0)	(0)	(0.00)	(0)	(0.00)	(764)	(24)	(9)	(3.94)	(21)	(3.65)	(1.51)

Table 5.4.2.6
Example of Results of a Taxi Stand Observation Survey

SUMMARY OF RESULTS OF TAXI STAND - URBAN TAXIS

TAXI STAND OBSERVATION FOR URBAN TAXIS

Taxi Type : Urban

Taxi Stand		Passenger					Taxi		Number of Recorded Occupied Taxis	Number of Recorded Empty Taxis	Number of Recorded Taxis
		Boarding	Queue Length		Waiting Time (Min.)		Queuing Time (Min.)				
			Max.	Ave.	Max.	Ave.	Max.	Ave.			
Central and Western	Rumsey Street (outside Vicwood Plaza)	962					21	4.33	485	311	796
	Star Ferry Concourse	1957	20	0.47	3	0.15	28	7.41	1322	143	1465
	Southern Kerb of slip road of Man Kwong Street	1001	11	0.3	7	0.21	39	7.57	670	105	775
	Southern Kerb of slip road of Man Kwong Street (Cross Harbour)	76	3	0.01	3	0.11	162	40.93	100	19	119
	Charter Road (outside Alexandra House)	1299	12	0.34	12	0.18	18	5.19	865	194	1059
	Admiralty MTR Station	3885	14	0.38	2	0.07	19	6.73	2456	335	2791
	Lung Wui Road	3	1	0.01			2	2	3		3
	Average for whole district	-	-	0.21	-	0.1	-	10.59			-
Wanchai and Eastern	Blue Pool Road	137	3	0.03	2	0.11	28	4.06	125	69	194
	Paterson Street (b/w Kingston Street and Gloucester Road) (Cross Harbour)	179					107	40.03	135	39	174
	Russell Street (within Times Square)	2612	25	5.92	9	1.61	15	4.54	1699	165	1864
	Chai Wan Road	224					54	13.05	220	20	240
	Sung Tak Street / Morrison Hill	191	4	0.01	2	0.03	81	23.28	156	51	207
	North Point Road	368	5	0.05	4	0.04	33	8.36	301	26	327
	Tai Koo Shing Road (opposite Tai Mou Road)	1013	4	0.02	1	0.02	38	7.24	658	112	770
	Public Transport Interchange at HKCEC Extension	2					19	9.5	6	3	9
	Lai Li Street (b/w Hing Fat Street and Electric Road) (Cross Harbour)	140					81	44.76	111	27	138
	Harbour Road (Opposite to Great Eagle Centre/Harbour Centre)	377					91	40.7	299	31	330
	Tai Hang Road (near Tiger Balm Garden)	7	1		1	0.14	86	39.25	15	4	19
	Average for whole district	-	-	0.55	-	0.18	-	21.34			-
Southern	Repulse Bay Road (opposite to Repulse Bay Apartment)	79	1		2	0.03	92	24.86	206	7	213
	Nam Ning Street (Southern Section)	444	4	0.03	4	0.05	39	12.01	285	39	324
	Lei Tung Estate	221	5	0.1	8	0.24	40	9.59	167	48	215
	Ap Lei Chau Estate (outside Bus Terminus)	341	3	0.02	5	0.04	48	13.84	260	24	284
	Beach Road	11	2		1	0.18	5	1.2	27	5	32
	Wah Kwai Estate	340	7	0.19	8	0.37	45	11.73	270	27	297
	Average for whole district	-	-	0.06	-	0.15	-	12.2			-
	Whole Hong Kong Island	15869	25	0.39	12	0.15	162	17.19	10841	1804	12645
Eastern Kowloon	Fuk Lo Tsuen Road	223	2	0.01			38	13.43	185	41	226
	Diamond Hill MTR Station Public Transport Interchange	778	7	0.13	11	0.09	31	14.07	523	33	556
	To Fuk Road	1837	9	0.1	7	0.04	35	13.11	1269	136	1405
	Wang Tau Hom South Road	327	9	0.29	13	0.62	31	7.47	265	30	295
	Yin Hing Street	192					41	10.96	201	7	208
	Lee On Road O/S Lee Yip Home, Shun Lee Estate	269	4	0.03	4	0.08	47	9.06	186	51	237
	Yue Man Square	1944	16	0.55	6	0.19	22	3.82	1275	47	1322
	Chuk Yuen Road	223	3	0.05	7	0.15	54	11.07	241	13	254
	Wai Wah Street	216	3	0.04	4	0.06	38	9.1	176	23	199
	Festival Walk	644	10	0.09	5	0.09	46	12.72	419	26	445
	Average for whole district	-	-	0.13	-	0.13	-	10.48			-
West and South Kowloon	Mong Kok KCR Station	2600	47	5.5	12	1.51	12	2.92	1625	243	1868
	Cameron Road near Cameron Lane	395					24	6.35	329	27	356
	Kowloon KCR Station	2775	85	8.61	23	2.23	25	9.44	1777	123	1900
	Kowloon KCR Station (Cross Harbour)	562					78	40.66	477	14	491
	Star Ferry Pier	942	2	0.01	2	0.01	43	14.38	653	20	673
	Dundas Street	130	5	0.11	5	0.39	49	7.13	98	6	104
	Austin Road o/s HK Scout Centre	402	5	0.04	6	0.06	48	11.22	329	13	342
	Tai Hang Sai Street	326	3	0.05	6	0.08	46	9.33	238	2	240
	Jordan Road, Ferry Pier	2							4	2	6
	Average for whole district	-	-	1.59	-	0.48	-	11.27			-

Table 5.4.2.7
Example of a Comparison Between a Taxi Stand Observation Survey with a Preceding Survey

COMPARSION WITH 2001 TAXI STAND OBSERVATION SURVEY

AVERAGE PASSENGER QUEUE LENGTH, AVERAGE PASSENGER WAITING TIME (MIN.) & AVERAGE TAXI QUEUING TIME (MIN.)

Taxi Type : Urban

AREA	AVERAGE PASSENGER QUEUE LENGTH						AVERAGE PASSENGER WAITING TIME						AVERAGE TAXI QUEUING TIME					
	2002		2001		Diff.	Significant?	2002		2001		Diff.	Significant?	2002		2001		Diff.	Significant?
	AVE.	S.E.	AVE.	S.E.			AVE.	S.E.	AVE.	S.E.			AVE.	S.E.	AVE.	S.E.		
Central & Western	0.21	0.06	1.87	0.83	-1.66	YES	0.1	0.02	0.5	0.18	-0.4	YES	10.59	3.92	11.5	5.25	-0.91	NO
Wan Chai & Eastern	0.55	0.46	0.05	0.02	0.05	NO	0.18	0.12	0.08	0.04	0.1	NO	21.34	4.24	12.8	4.31	8.54	YES
Southern	0.06	0.02	0.11	0.04	-0.05	NO	0.15	0.04	0.21	0.06	-0.06	NO	12.2	1.97	10.06	2.3	2.14	NO
WHOLE HONG KONG ISLAND	**0.39**	**0.27**	**0.52**	**0.21**	**-0.13**	**NO**	**0.15**	**0.07**	**0.21**	**0.05**	**-0.06**	**NO**	**17.19**	**2.72**	**12.08**	**2.94**	**5.11**	**NO**
East Kowloon	0.13	0.05	0.18	0.09	-0.05	NO	0.13	0.05	0.09	0.02	0.04	NO	10.48	0.9	9.28	1.46	1.2	NO
West & South Kowloon	1.59	0.93	3.64	2.05	-2.05	NO	0.48	0.24	1.26	0.53	-0.78	YES	11.27	3.43	12.26	4.26	-0.99	NO
Tsuen Wan & Kwai Chung	0.18	0.05	0.24	0.08	-0.06	NO	0.19	0.05	0.41	0.15	-0.22	NO	6.81	1.39	8.11	1.21	-1.3	NO
Sha Tin	0.14	0.03	0.2	0.07	-0.06	NO	0.2	0.05	0.2	0.05	0.00	NO	16.49	2.23	11.77	1.68	4.72	YES
WHOLE KOWLOON METROPOLITAN	**0.53**	**0.25**	**1.11**	**0.55**	**-0.58**	**NO**	**0.25**	**0.07**	**0.47**	**0.14**	**-0.22**	**YES**	**11.57**	**1.11**	**10.45**	**1.32**	**1.12**	**NO**
URBAN AREA OVERALL	**0.48**	**0.19**	**0.93**	**0.38**	**-0.45**	**NO**	**0.22**	**0.05**	**0.39**	**0.1**	**-0.17**	**YES**	**13.38**	**1.16**	**10.96**	**1.29**	**2.42**	**YES**
Tuen Mun and Yuen Long	0.01	0.01	0.00	0.00	0.01	NO	0.00	0.00	0.01	0.01	-0.01	NO	56.36	13.55	71.41	18.63	-15.05	NO
North New Territories	0.00	0.00	0.00	0.00	0.00	NO	0.00	0.00	0.11	0.09	-0.11	NO	74.95	13.8	66.4	18.92	8.55	NO
Sai Kung	0.08	0.03	0.17	0.09	-0.09	NO	0.11	0.03	0.09	0.03	0.02	NO	27.58	6.59	15.96	3.99	11.62	YES
NEW TERRITORIES OVERALL	**0.02**	**0.01**	**0.04**	**0.02**	**-0.02**	**NO**	**0.02**	**0.01**	**0.07**	**0.04**	**-0.05**	**NO**	**57.22**	**7.85**	**57.73**	**10.53**	**-0.51**	**NO**

Table 5.4.2.8
Example of Hourly Variations for Taxi Stand Survey

Results of Taxi Stand Survey
Queue Length and Waiting Time of Passengers and Taxis at Taxi Stand

Code : SKW31

Location : Star Ferry Pier

Area : West & South Kowloon

Taxi Type : Urban

HOUR BEGINNING	PASSENGER						TAXI						AVERAGE NUMBER OF PASS PER TAXI
	BOARDING	LEAVING QUEUE	QUEUE LENGTH		WAITING TIME (MIN.)		TOTAL NUMBER DEPARTING		QUEUE LENGTH		WAITING TIME (MIN.)		
			MAX	AVE	MAX	AVE	WITH PASS.	W/O PASS.	MAX	AVE	MAX	AVE	
07:00	29	0	0	0.00	0	0.00	16	2	6	4.00	24	11.52	1.81
08:00	73	0	2	0.10	2	0.08	49	7	14	6.22	27	8.95	1.49
09:00	57	0	0	0.00	0	0.00	34	8	19	15.20	30	25.56	1.68
10:00	45	0	0	0.00	0	0.00	29	17	23	19.12	43	36.86	1.55
11:00	68	0	0	0.00	0	0.00	42	9	19	15.28	30	21.56	1.62
12:00	85	0	0	0.00	0	0.00	50	4	17	13.40	22	15.77	1.70
13:00	93	0	0	0.00	0	0.00	55	8	18	13.62	22	14.80	1.69
14:00	94	0	0	0.00	0	0.00	61	12	16	12.33	18	11.39	1.54
15:00	91	0	0	0.00	0	0.00	59	3	16	10.20	18	10.43	1.54
16:00	112	0	1	0.03	2	0.02	72	8	17	6.52	15	5.80	1.56
17:00	74	0	0	0.00	0	0.00	39	14	16	9.73	22	11.92	1.90
18:00	121	0	0	0.00	0	0.00	67	8	20	15.83	23	15.21	1.81
Total	**942**	**0**	**2**	**0.01**	**2**	**0.01**	**573**	**100**	**23**	**11.81**	**43**	**14.38**	**1.64**
(2001 Total)	(1050)	(7)	(6)	(0.12)	(4)	(0.08)	(627)	(186)	(27)	(10.18)	(44)	(11.71)	(1.67)

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Table 5.4.2.9
Example of the Results of a Roadside Observation Survey

RESULTS OF SURVEY
TAXI ACTIVITY AND LEVEL OF SERVICE AT INDIVIDUAL LOCATION (0700 - 1900 HRS)

Area: Central & Western - Hong Kong Island
Taxi Type: Urban

LOCATION		BOUND	NUMBER OF TAXIS (0700 - 1900 HOURS)							AVERAGE PASSENGERS PER OCCUPIED TAXI	HEADWAY BETWEEN VACANT TAXI (MIN.)	
			VACANT		OCCUPIED		"NOT FOR HIRE"		TOTAL			
			NO	%	NO	%	NO.	%			MAX.	AVE.
RHC1	Connaught Road FO	E	166	5.1%	2805	85.5%	308	9.4%	3279	1.33	40	4.34
RHC1	Connaught Road FO	W	1326	25.9%	3477	67.9%	321	6.3%	5124	1.37	17	0.54
RHC2	Connaught Road Central W/O Jackson Road	E	2698	18.9%	10800	75.5%	806	5.6%	14304	1.39	5	0.27
RHC2	Connaught Road Central W/O Jackson Road	W	3201	22.0%	10802	74.3%	540	3.7%	14543	1.33	3	0.22
RHC3	Connaught Road West	E	495	20.7%	1723	72.1%	173	7.2%	2391	1.37	152	1.45
RHC3	Connaught Road West	W	1704	36.5%	2601	55.7%	361	7.7%	4666	1.37	25	0.42
RHC4	Garden Road E/O Upper Albert Road	E	2717	29.7%	6170	67.6%	246	2.7%	9133	1.35	23	0.26
RHC5	Harcourt Road FO	E	1192	14.7%	6100	75.4%	801	9.9%	8093	1.35	9	0.60
RHC5	Harcourt Road FO	W	2269	18.5%	9556	77.9%	441	3.6%	12266	1.38	5	0.32
RHC6	Pok Fu Lam Road E/O Hill Road Flyover	E	998	48.8%	997	48.8%	50	2.4%	2045	1.41	24	0.72
RHC6	Pok Fu Lam Road E/O Hill Road Flyover	W	642	29.8%	1357	63.0%	155	7.2%	2154	1.39	25	1.12
RHC7	Queen's Road Central E/O Pottinger Street	W	1329	41.9%	1731	54.5%	114	3.6%	3174	1.35	7	0.54
RHC8	Queensway	E	4112	33.1%	7718	62.1%	591	4.8%	12421	1.34	3	0.18
RHC8	Queensway	W	833	16.5%	4159	82.2%	67	1.3%	5059	1.31	9	0.86
AVERAGE				24.2%		70.8%		5.0%		1.36	152	0.41

NOTES:
(1) The results should be used with caution for the number of vacant taxi is between 1 to 5 due to small sample size obtained in the survey.
(2) N/A means the headway between vacant taxis is not applicable due to small sample size obtained in the survey.
(3) Sum may not add up to 100% due to figure rounding.

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Table 5.4.2.10
Summary of Results of a Roadside Observation Survey

SUMMARY OF RESULTS - URBAN TAXIS
ROADSIDE OBSERVATION (0700 - 1900 HOURS)

Taxi Type: Urban

AREA	VACANT TAXIS (%)	OCCUPIED TAXIS		"NOT FOR HIRE TAXIS" (%)	NO. OF PASS. PER OCCUPIED TAXI	HEADWAY BETWEEN VACANT TAXIS (Min.)			Number of Recorded Taxis
		(%)	S.E.			MAX.	AVE.	S.E.	
HONG KONG ISLAND									
Central and Western	24%	71%	0.03	5%	1.36	152	0.41	0.08	98652
Wan Chai and Eastern	22%	71%	0.02	6%	1.35	88	0.64	0.15	68542
Southern	35%	58%	0.07	7%	1.45	187	1.94	0.25	15610
WHOLE HONG KONG ISLAND	24%	71%	0.02	5%	1.36	187	0.56	0.10	182804
KOWLOON METROPOLITAN									
East Kowloon	29%	64%	0.01	8%	1.34	38	0.54	0.13	94041
West and South Kowloon	28%	66%	0.03	6%	1.36	236	0.81	0.15	48825
Tsuen Wan and Kwai Chung	33%	61%	0.02	6%	1.34	233	1.01	0.21	26940
Shatin	35%	61%	0.04	4%	1.37	67	1.21	0.23	35223
WHOLE KOWLOON METROPOLITAN	30%	63%	0.01	7%	1.35	236	0.75	0.10	205029
URBAN AREA OVERALL	27%	67%	0.01	6%	1.36	236	0.67	0.08	387833
NEW TERRITORIES									
Tuen Mun and Yuen Long	55%	39%	0.13	6%	1.56	720	28.38	19.73	1025
Sai Kung	32%	61%	0.04	7%	1.45	136	2.45	0.40	11558
North New Territories	40%	52%	0.06	8%	1.29	360	16.08	10.17	1153
NEW TERRITORIES AREA OVERALL	33%	60%	0.04	7%	1.44	720	4.60	1.36	13736
OVERALL (3)	27%	67%	0.01	6%	1.36	720	1.08	0.17	401569

Note:
(1) S.E. denotes Standard Error
(2) Figure may not add up to the total due to rounding
(3) Overall = Urban Area Overall + New Territories Area Overall

5.4.3 Survey of Taxi Utilization and Operating Finance

5.4.3.1 Objectives:

(i) To obtain utilization and operating economic data for continuous and close monitoring of taxi operation and for policy review.

(ii) To facilitate processing of any taxi fare revision application.

5.4.3.2 Objectives:

(i) Structure of Survey: The survey is normally composed of three parts.

(a) A questionnaire survey on taxi operating economics through the mailing of questionnaires containing questions on operating characteristics and costs to the selected samples of taxi operators.

(b) A meter reading survey by requesting the sampled taxis to be driven to appointed centres for recording details of meters.

(c) An interview survey on taxi passenger to assess tipping income of taxi service.

(ii) Timing and Duration: The survey should be conducted periodically, preferably once every year, or at least in response to any application for fare revision. Due care in fixing the timing of the survey has to be taken to avoid the seasonal influence. Taxi owners/operators would be required to complete a questionnaire and to present their vehicles at specific centres twice, or five times for Lantau taxis, with a time interval of one week in between for the meter reading.

(iii) Selection of Samples: Based on an updated list of taxi registration obtained from the VALID and Licensing Division, samples of taxis are selected randomly for the survey. The number of sample selections depends on the size of the population and the expected response rates of the survey. To save resources, the samples sizes should be reviewed periodically according to the precision levels of the response rates of the survey. Presently, the following samples of taxis are selected:

(a) Urban taxis - Taxis with its last digit of registration number equal to a randomly selected digit

(b) N.T. taxis - Whole population with Patent VIP taximeter

(c) Lantau taxi - Whole population

(iv) Selection of Meter Reading Centres: Meter Reading Centres are set up for recording the meter details of the selected taxis presented twice at the centres. The number of meters selected should be commensurate with the size of the samples as well as the staff resources available. Generally speaking, the centres should be located at popular and easily accessible sites having capacity to accommodate a few taxis without causing obstruction to traffic. The Police would be consulted on the suitability of the sites for taxi meter reading where necessary. Besides, the centres should, as far as possible, provide shelters to survey staff and sampled taxi drivers in the hope that the response rate could be higher.

(v) Design of survey Sheets and Questionnaires: Four forms would be designed in the planning stage.

(a) The questionnaire requesting for information on the operating characteristics and costs. The questions to be asked in the questionnaire depend on the scale of the study. A sample of the questionnaires used in previous surveys is shown at Appendix IX.

(b) The Taxi Meter Reading Form for recording meter information. Samples of the taxi meter reading forms are shown at Appendix X.

(c) The sundry income survey form recording tips given by passengers, luggage fees, surcharges on radio-bookings and tunnel tolls. A sample is shown at Appendix XI.

(d) The surveyor# record sheet, sample of which is shown at Appendix XII, is the records kept by the surveyors for overall control of the meter reading information.

(vi) Deployment of survey Staff: Two surveyors would normally be required to man a meter reading centre. At popular locations, three or more surveyors would be needed to cope with the vast no. of turn-ups. Before conducting of the field work, a briefing session for the surveyors would be required:

(a) to familiarize them with the types of meters to be encountered;

(b) to brief them of the information required to be recorded down; and

(c) to draw their attention to crucial points to be noted in that specific year.

5.4.3.3 Data Collection:
The following data is to be collected:

(i) From Meter Reading

(a) total kilometre operated;

(b) paid kilometre operated;

(c) number of hire trips; and

(d) number of units.

This information is displayed on taximeters. Taxi drivers are requested to complete the daily readings in the period between the first and the second readings on the Taxi Meter Reading Form distributed to them when they first turn up. These forms are collected back by the field staff upon the completion of the second reading.

(ii) From the Questionnaire:

(a) way of operation, whether it be individually or company owned, whether it be driven by the owner, a driver or a sharer;

(b) operating characteristics such as the major area of operation, the average number of operating days per months, etc; and

(c) expenditure items, including:

- drivers' remuneration;

- fuel and lubricants;
- repair and maintenance;
- administration expenses;
- miscellaneous expenses such as insurance, membership fee, etc.; and
- parking fee.

5.4.3.4 Data Analysis:
The data collected from the questionnaires and the meter reading surveys is analysed broadly as follows.

(i) Information obtained from the two sources is matched together to indicate the corresponding revenue and expenditures.

(ii) Other than providing the overall statistics, various records are separated into groups according to their way of operations for detailed analysis of the taxi utilization statistics, average operating revenue and average operating expenditures.

5.4.3.5 Result Presentation:
Results should indicate:

(i) response rate of survey;

(ii) taxi utilization statistics;

(iii) meter receipts;

(iv) monthly profit/loss for an average taxi, a taxi owner and a taxi hirer and its comparison with the findings of the last survey;

(v) cash flow analysis;

(vi) monthly earning per shift of a taxi driver and its comparison with the findings of the last survey;

(vii) comparison of utilization between the survey year and the previous year;

(viii) monthly profit/loss of an average Lantau taxi analysed by weekdays, Saturdays, Sundays and public holidays; and

(ix) results of sundry income survey for Lantau taxis.

5.4.4 Survey on Utilization of Taxi Stands

5.4.4.1 Objectives:
To obtain information on:

(i) the number of taxis calling at the stand during a specific period;

(ii) the purpose of a taxi calling at the stand and its duration of stay; and

(iii) the number of passengers utilizing the stand facility.

5.4.4.2 Survey Design:
Select the taxi stand as well as the period for the conduct of the survey.

5.4.4.3 Data Collection
The following data is to be collected:

(i) the number and type of vehicles, taxis or otherwise, calling at the stand;

(ii) the purpose of the vehicles using the stand, e.g. for hire, parking, loading/unloading goods, cleansing or changing shifts; and

(iii) in the case of the stand being used for hire, the number of passengers picked up or set down. Otherwise, the purpose and duration of stay of the vehicles using the taxi stand.

Specimen survey sheet is shown at Table 5.4.4.1.

5.4.4.4 Data Analysis:
The following analysis is to be carried out:

(i) the number of taxis and other vehicles calling at the stand;

(ii) the purposes and duration of using the stand; and

(iii) adequacy of space provided for taxi hiring purposes.

5.4.4.5 Results Presentation:
Results are presented in a summary form showing the number, purposes, as well as the duration of taxis using the stand at an hourly interval. Specimen form is shown at Table 5.4.4.2.

Table 5.4.4.1
Summary of Survey Results on Utilization of Taxi Stand

Location :_____ Code :_____

No. of Spaces :_____ Date & Day :_____ Period :_____

Surveyor :_____ Weather :_____

Reg. No.	Type of Vehicle	Purpose of Using the Stand				Time		
		Passengers		Loading/ Unloading Goods	*Parking	In	Out	Duration
		S/D	P/U					

* case of taxi, please state : (a) out of service
(b) cleansing
(c) changing shift

Table 5.4.4.2
Summary of Survey Results on Utilization of Taxi Stand

Summary of Results

Location of Taxi Stand :_____ Surveyor : _____

Code : _____ Weather : _____

No.of Spaces : _____ Date, Day & Time : _____

Time (Hourly Period)	No. of Taxis using the Stand							Duration of Parking or Other Use (Hour : mins)		
	For Hire			For Other Purpose						
	In	Out	Min. - Max. No. of Taxi at Stand at one time	Parking	Cleansing	Changing Shift	Other	Min.	Max.	Ave
Total										
No. of taxis remaining at Stand at end of Survey :										

5.5 Red Mini Bus (RMB) Operation Survey

5.5.1 Introduction

The public light bus (PLB) was first introduced as a legal form of public transport in 1969. Non-scheduled PLBs do not operate according to fixed routes or timetables, and do not observe fixed stops or charge pre-set fares. Even so, PLB routes have emerged over the years and remain relatively stable through time with a network of about 160 routes. PLBs, also known nowadays as "red minibus"(RMB), are distinguished by a primrose yellow livery with a red roof (since 1 April 1995).

In 1972, a new form of public transport evolved from the PLB. Originally, this mode was known as the "maxicab" and maxicab routes operated under franchises with regular schedules, routes and fares. Franchises were replaced by passenger service licences in 1984 and the "maxicabs" are now generally referred to as "green minibus" or GMBs. Their livery is primrose yellow with a green roof (since 1 April 1995).

As the total number of PLB registrations is frozen, the growth in GMB registrations since 1976 has resulted in the corresponding reduction in RMB registrations. In May 2006, there were 2,768 licensed GMBs and 1,581 RMBs.

Regular updating of information and statistics on operational characteristics of both GMBs and RMBs are required for monitoring their performance. Whilst statistics on GMBs can be derived from the returns of operators, information on the operation of RMBs can be obtained by surveys. The following Section 5.5.3provides descriptions of the survey methodology adopted.

5.5.2 Survey Objective

The objective of the survey is to update information on the operational characteristics of RMB by conducting field observations on a territory-wide basis. The information on the routeings, vehicle and passenger trips, etc. of RMBs is obtained.

5.5.3 Survey Methodology

5.5.3.1 Route InventoryIn the inception of PLB survey carried out in 1972, a detailed inventory of PLB routes was established, using observers travelling on PLBs as fare-paying passengers and recording details of the routes followed. This route inventory has been updated in each of the subsequent surveys and has been amended to show exclusively RMB routes since 1980. In this route inventory, RMB routes are divided into four groups:

(i) Group 1 - Hong Kong Island routes

(ii) Group 2 -Kowloon Urban routes

(iii) Group 3 -Kowloon-N.T. routes

(iv) Group 4 - N.T. Domestic routes

These routes have been numbered according to the group into which they fall and index letters (Ref. No.) have been added to identify individual routes within the group. There is no significance to the sequence of the letters.

5.5.3.2 Screenline Observation

Before the commencement of any updating survey, a reconnaissance of route changes should be carried out to review whether there is a need to amend the existing screenlines. Screenline observations form the most basic part of the RMB survey. Each route is at least intercepted by a common screenline. Sometimes, it is necessary to establish supplementary screenlines to obtain adequate information for the analysis of route passenger volumes.

At each screenline, observations are carried out during the 16-hour period between 7.00 a.m. and 11.00 p.m. on a weekday to record the destination, fare and occupancy of every RMB crossing.

5.5.3.3 On-vehicle Survey

An "on-vehicle" survey is required to establish "expansion factor"to convert passenger volumes observed at screenlines to passenger volumes along the route. It is conducted by observers travelling on board sampled vehicles to record each passenger boarding and alighting along the whole route. For each route, one vehicle is sampled for each direction of travel in each hour during the 16-hour survey period from 7.00 am to 11.00 pm. The weighted (by the number of vehicle trips) average of the route passenger volume observed for each hour gives the overall "expansion factor" for that particular route.

Since the surveyor occupies one seat of the sampled vehicle and consequently may affect the results of the survey, a procedure is devised such that the surveyor would include him/herself as a fare paying passenger. If the sampled vehicle is full at any point. This would minimize any distortion caused by the survey.

Since RMB routes do not have fixed stops, routes and divided into sections and the surveyor records the boarding/alighting that occur within a section. The following guidelines are adopted when designing route section breakpoints:

- where the fare changes on the route;
- where there is an obvious identifiable landmark;
- where the routeing changes from one to another; and
- where there is a major change in land-use.

As such on-vehicle surveys are very resource-consuming, then all routes are not covered every survey instead an approximate 30% sample is covered each survey on a rotational sequence.

5.5.4 Result Presentation

The results of the survey are presented to show the characteristics for each RMB route which include "mean Length of Route", "no. of Vehicle Trips", "Vehicle-Kilometer"and "No. of Passenger Trips". An example of tabulation is shown in Table 5.5.4.1. Apart from presentation of results for individual routes, a summary table comparing territory-wide overall characteristics of RMBs with previous years is also included as shown in Table 5.5.4.2

Table 5.5.4.1

RMB Route Characteristics in 1988 (& Comparison with 1987*)
Hong Kong Island (Weekday - 16 Hour)

ROUTE		MEAN LENGTH (km)	VEHICLE TRIPS. (No.)	VEHICLE KILOMETER (km)	PASSENGER TRIPS. (No.)
REF. NO.	DESCRIPTION				
103	Sheung Wan/Central - Aberdeen	9.14	905 (1485)	8272 (13573)	13753 (26311)
104	Sheung Wan/Central - Wah Fu	7.88	597 (38)	4704 (299)	9558 (793)
106	Kennedy Town - Aberdeen	7.26	527 (523)	3826 (3797)	7299 (7850)
107	Tin Wan - Aberdeen	1.74	552 (562)	960 (978)	6296 (5877)
108	Shek Pai Wan - Aberdeen	0.85	1199 (1196)	1019 (1017)	13924 (10219)
109	North Point - Kennedy Town	9.27	792 (633)	7342 (5868)	16843 (9166)
110	Wong Chuk Hang - Aberdeen	1.90	1260 (1621)	2394 (3080)	12281 (13493)
111	Kennedy Town - Central	3.51	389 (517)	1365 (1815)	4943 (5709)
112	Kennedy Town - Daimaru	6.89	3017 (3542)	20787 (24404)	58862 (57391)
114	Sheung Wan/Central - Quarry Bay	7.60	663 (27)	6570 (205)	7422 (305)
115	Quarry Bay - Wan Chai	5.65	- (83)	- (469)	- (733)
116	Chai Wan - Wan Chai	9.99	477 (547)	4765 (5465)	9738 (7045)
117	Shau Kei Wan - Wan Chai	8.31	1759 (2634)	14617 (21889)	26103 (30739)
120	Shau Kei Wan - Chai Wan	2.56	347 (449)	888 (1149)	3618 (4578)
121	Aberdeen - Wah Fu	2.26	424 (689)	958 (1557)	3686 (5680)
122	Wan Chai - North Point	4.18	61 (98)	255 (410)	583 (981)
123	Wan Chai - Sai Wan Ho	7.03	278 (379)	1954 (2664)	4553 (2941)
125	Daimaru - Wah Fu	10.38	242 (180)	2512 (1868)	3440 (2218)
127	Sheung Wan/Central - Sai Wan Ho	8.85	178 (77)	1575 (681)	2812 (884)
129	Kennedy Town - Sai Wan Ho	12.36	85 (128)	1051 (1582)	1004 (2847)
131	Sheung Wan/Central - Wong Chuk Hang	11.04	68 (171)	751 (1888)	940 (762)

* 1987 figures are shown in brackets

Table 5.5.4.2
Comparison of RMB Weekday Characteristics (16-Hour) 1979 - 1988

CHARACTERISTICS	1979	1980	1981	1982	1983	1984	1985	1986	1987	1988	% Change 88/87
1. Number of RMB registered	4 169	4 007	3 976	3 771	3 528	3 407	3 302	3 208	3 128	3 061	-2.1
2. Number of vehicle trips	90 611	86 084	88 231	79 898	75 618	76 288	74 796	71 091	69 125	66 673	-3.5
3. Passengers carried (No.)	1 206 249	1 160 136	1 131 423	945 147	878 017	899 885	888 092	857 076	846 006	816 440	-3.5
4. Total vehicle kilometres	717 851	667 512	698 569	619 963	612 777	624 449	595 927	548 720	530 371	513 616	-3.2
5. Average vehicle Trip length (km)	7.9	7.8	7.9	7.8	8.1	8.2	8	7.7	7.7	7.7	+0.0
6. Average trips per vehicle (No.)*	24	24	25	24	24	25	25	25	25	24	-3.2
7. Average distance covered per vehicle (km)*	191.3	185.1	195.2	182.7	193	203.6	200.5	190.1	188.4	186.4	-1.1
8. Passenger per vehicle km (No.)	1.68	1.74	1.62	1.52	1.43	1.44	1.49	1.56	1.6	1.59	-0.6
9. Passenger per vehicle trip (No.)	13.31	13.48	12.82	11.83	11.61	11.8	11.87	12.06	12.24	12.25	-0.1
10. Passenger per vehicle* (No.)	321	322	317	279	277	293	299	297	300	296	-1.3

Note :
1.* Assume 10% of vehicle fleet were off the road for repair servicing etc.
2. Cross harbour trips included.

Appendix I

Specific Conditions and Display Sign for Non-franchised Public Bus Service

Service Type	Conditions	Display Sign for Service Type
Tour (A01)	• Licensing Conditions for a Non-franchised Bus • Passenger Service Licence Conditions for Public Bus	Yellow sign with black letters in both Chinese and English indicating the service type. Sign displayed on the windscreen or front destination indicator of the bus while the service is in operation. Suggested size of sign on the windscreen is 12cm x 30cm. [Re. Passenger Service Licence Conditions for Public Bus]
Hotel (A02)	• Licensing Conditions for a Non-franchised Bus • Passenger Service Licence Conditions for Public Bus	Ditto
Student (A03)	• Licensing Conditions for a Non-franchised Bus • Passenger Service Licence Conditions for Public Bus Some specific conditions: ◦ Student service for kindergarten or primary students operated by buses specified in this licence, whether by the licensee or by another person under a contract of hire, shall be subject to the provision of escort while the service is in operation. ◦ Payment of fares of student service, except student service for post-secondary education establishments, must be collected in the form of pre-paid fares (e.g. coupons or monthly tickets), and no fares for one single journey being made immediately shall be collected at the boarding point(s) or on board the bus which is providing the student service.	Ditto
Employees' (A04)	• Licensing Conditions for a Non-franchised Bus • Passenger Service Licence Conditions for Public Bus Some specific conditions: ◦ Operation of Employees' Service shall comply with the "Conditions for Operating Employees' Service" and in accordance with "Details of Approved Employees' Service". ◦ Prior approval must be sought from C for T for any change in the employer in respect of Employees' Service or to the location of workplace. Written notification must be given to C for T for any change in other details of service including picking-up and setting down points at employees' residence, operation hours and fares. • Conditions for Operating Employees' Service Some specific conditions: ◦ Unless otherwise permitted, operation of an employees' service shall be subject to the condition that a bus must only carry employees for one employer at any one time. ◦ The passengers of an employees' service shall be in the employ of the employer providing the service, and shall be required to produce identification documents e.g. staff cards or boarding coupons before boarding. ◦ The payment of fares of employees' service must be made at a place other than the boarding points of on board and must be made in the forms of pre-paid fares (such as coupon or monthly ticket).	2 signboards (each measuring 12cm x 30cm) are to be on display indicating "EMPLOYEES' SERVICE" and the name of employer respectively. • be in both Chinese and English (black colour) on a yellow background • be displayed on the windscreen or the front destination indicators of bus • be made of plasticnot be displayed when the said service is not being operated [Re. Conditions for Operating Employees' Service]

Service Type	Conditions	Display Sign for Service Type
International Passenger Service (A05) Cross-boundary service	• Licensing Conditions for a Non-franchised Bus • Passenger Service Licence Conditions for Public Bus Some specific conditions: ◦ Operation of International Passenger Service shall comply with the Schedule of Service and Conditions for Operating International Passenger Service. ◦ The Schedule of Service, and any subsequent amendments, shall be effective after C for T has granted approval in writing. The schedule, and any subsequent application for amendments, shall be delivered to C for T not less than 14 days prior to the date on which the applicant proposes it should become effective. • Conditions for Operating International Passenger Service Some specific conditions: ◦ The service(s) shall only be operated in accordance with the terminals, stopping places, number of approved crossings and other requirements as specified in the Schedule of Service annexed to the Passenger Service Licence.	A sign identifying the destination of service on the front of the vehicle when providing the service. [Re. Conditions for Operating International Passenger Service]
International Passenger Service (A05) Non cross-boundary service	• Licensing Conditions for a Non-franchised Bus • Passenger Service Licence Conditions for Public Bus Some specific conditions: ◦ The operation of the International Passenger Service for the Mass Transit Railway Corporation shall only serve the passengers of the Airport Express Line. Combined fare shall be charged for the Airport Express Line ride and the bus service. The licensee shall take adequate measures such as inspection on board to safeguard against the abuse of International Passenger Service by non-Airport Express Line passengers. • Conditions for Operating International Passenger Service Some specific conditions: ◦ The service(s) shall only be operated in accordance with the route, stopping places, period and days of operation, timetable, fares and other requirements specified in the Schedule(s) of Service annexed to the Passenger Service Licence. Prior approval must be sought from C for T for any change to the Schedule of Service.	2 signboards (each measuring 12cm x 30cm) are to be on display indicating "INTERNATIONAL PASSENGER SERVICE" and the destination of service. The signs should • be in both Chinese and English (black colour) on a yellow background • be displayed on the windscreen or the front destination indicators of bus • be made of plastic • not be displayed when the said service is not being operated [Re. Conditions for Operating International Passenger Service]
Residents' Service (A06)	• Licensing Conditions for a Non-franchised Bus • Passenger Service Licence Conditions for Public Bus Some specific conditions: ◦ Operation of Residents' Service shall comply with the Schedule of Service and Conditions for Operating Residents' Service. ◦ The Schedule of Service, and any subsequent amendments, shall be effective after C for T has granted approval in writing. The schedule, and any subsequent application for amendments, shall be delivered to C for T not less than 14 days prior to the date on which the applicant proposes it should become effective. • Conditions for Operating Residents' Service Some specific conditions: ◦ Each bus while operating a residents' service authorised under this passenger service licence shall display a copy of the Details of Approved Residents' Service (specifying the service's routing and stopping points) certified by the Commissioner. The Details of Approved Residents' Service shall be displayed on the nearside front window of the bus; and shall be placed in such a position that the sightline of the driver would not be unduly obstructed. The Details of Approved Residents' Service shall not be displayed when the bus is not operating the said service.	A sign indicating the words RESIDENTS' SERVICE, the service's destinations and route number assigned by the Commissioner. The sign shall be: • made of plastic • yellow colour and black letter • on the windscreen of the bus • be displayed when the bus is operating the said service.

Service Type	Conditions	Display Sign for Service Type
Multiple Transport (A07)	• Licensing Conditions for a Non-franchised Bus • Passenger Service Licence Conditions for Public Bus	-
Contract Hire (A08)	• Licensing Conditions for a Non-franchised Bus • Passenger Service Licence Conditions for Public Bus Specific conditions for Free Bus Service: ◦ Any service operated by buses specified in this licence or under the control of the same licensee, other than the types of public bus services specified in Section 4(3) of the Public Bus Services Ordinance (Cap. 230), with a fixed route or fixed destination area and operated for more than 14 days either consecutively or intermittently during a continuous period of 12 months on which carriage is offered to any member of the public, should be subject to the prior approval of the Commissioner for Transport in writing. ◦ An application to operate such a service, or to vary a service already approved, shall be delivered to the Commissioner for Transport not less than fourteen days prior to the date on which the applicant proposes it shall commence operation. ◦ The Commissioner for Transport may refuse the application or may specify the route, timetable, number and type of vehicles allocated and stopping places.	Yellow sign with black letters in both Chinese and English indicating the service type. Sign displayed on the windscreen or front destination indicator of the bus while the service is in operation. Suggested size of sign on the windscreen is 12cm x 30cm. [Re. Passenger Service Licence Conditions for Public Bus]

Appendix II

居民巴士標誌

認可居民巴士服務細則
(Details of Approved Residents' Service)

客運營業證證明書
(Passenger Service Licence Certificate)

運 輸 署
TRANSPORT DEPARTMENT

客運營業證證明書
Passenger Service Licence Certificate

02174717

003771A

Vehicle Registration Mark DL871 X

Expiry Date 18/10/2001

Type of Service A06**********
****
****

Restriction Codes NR211, NR512********
****
****
****
****
****
****

Transaction A26-0137 Issued 08/05/2001

T.O. 3658 (Rev. 2000)

客運營業證字牌
(PSL Plate)

紅色:非專線服務

綠色:專線服務

Appendix III

TRANSPORT DEPARTMENT 運輸署 Appendix III

PASSENGER SERVICE LICENCE CONDITIONS 客運營業證條件

Registration Marks of the Vehicles 車輛登記號碼	
Class of Vehicle 車輛類別	Public Bus 公共巴士
Types of Service Permitted 批准服務種類 (Please refer to paragraph 1 of the Explanatory Notes attached) [illegible]	Non-scheduled Services – 非專利巴士服務 Scheduled Services – 專利
Area and Routes Permitted 批准經營服務之地區 / 路 (Please refer to paragraph 2 of the Explanatory Notes attached) [illegible]	Residents' Service Route Nos.: 居民服務路線 International Passenger Service (Cross Boundary Service), control point code nos.: [illegible]
PSL Certificate(s) Expiry Date 客運營業證證明書屆滿日期	

Criteria for vetting applications for non-franchised bus services

In determining an application for operation of any non-franchised bus services, the Commissioner for Transport shall take into account, in addition to any other matter which he considers relevant to the application, all matters as stipulated in section 28 of the Road Traffic Ordinance, Cap. 374.

[illegible]

[illegible]

Conditions 條件 (Please read in conjunction with the attached Explanatory Notes) (請參閱夾附說明)

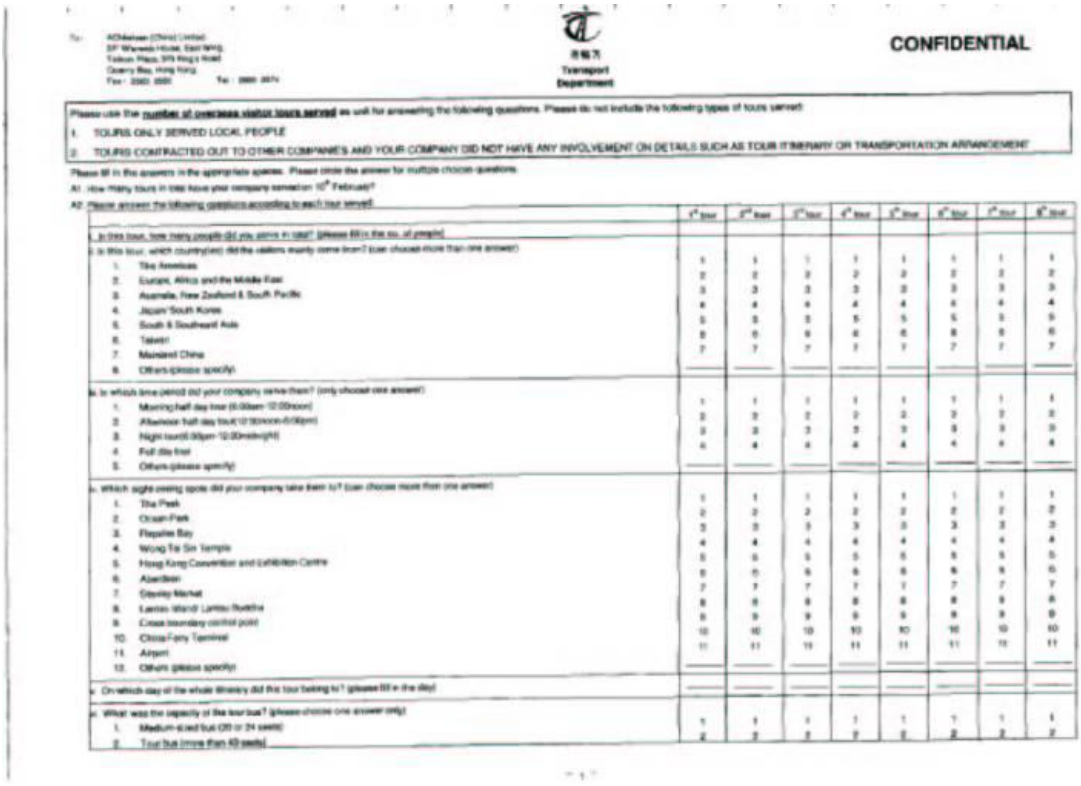
1. Any service operated by buses specified in this licence or under the control of the same licensee, other than the types of public bus services specified in Section 4(3) of the Public Bus Services Ordinance (Cap. 230), with a fixed route or fixed destination area and operated for more than 14 days either consecutively or intermittently during a continuous period of 12 months or which carriage is offered to any member of the public, should be subject to the prior approval of the Commissioner for Transport in writing.
   An application to operate such a service, or to vary a service already approved, shall be delivered to the Commissioner for Transport not less than fourteen days prior to the date on which the applicant proposes it shall commence operation.
   The Commissioner for Transport may refuse the application or may specify the route, timetable, number and type of vehicles allocated and stopping places.
   [illegible]
2. The operation of an International Passenger Service and a Residents' Service or any one of them shall comply with the attached Schedule of Service and conditions for operating these services. The Schedule of Service, and any subsequent amendments, shall be effective after the Commissioner for Transport has granted approval in writing. The Schedule, and any subsequent application for amendments, shall be delivered to the Commissioner for Transport not less than 14 days prior to the date on which the applicant proposes it should become effective. (This condition is applicable to an International Passenger Service and a Residents' Service or any one of them)
   [illegible]
3. The operation of the International Passenger Service for the Mass Transit Railway Corporation shall only serve the passengers of the Airport Express Line. Combined fare shall be charged for the Airport Express Line ride and the bus service. The licensee shall take adequate measures such as inspection on board to safeguard against the abuse of the International Passenger Service by non-Airport Express Line passengers. (This condition is applicable to an International Passenger Service for the Mass Transit Railway Corporation)
   [illegible]
4. The operation of an Employees' Service shall comply with the conditions for operating this service and in accordance with the Details of the Approved Employees' Service attached hereto. Prior approval must be sought from the Commissioner for Transport for any change in the employer in respect of the Employees' Service or to the location of workplace. Written notification must be given to the Commissioner for Transport for any change in other details of service including picking-up and setting down points at employees' residences, operation hours and fares. (This condition is applicable to an Employees' Service)
   [illegible]
5. The licensee is required to retain records of vehicle maintenance (including both routine servicing and unscheduled repairs) for a period of two years and to produce them, if requested, by the Commissioner for Transport or his representative. (Please refer to paragraph 3 of the Explanatory Notes attached)
   [illegible]
6. A sign indicating the type of non-scheduled public bus service that is approved under this licence and being operated by the bus at that time shall be prominently displayed on the windscreen or the front destination indicator of the bus at all time while the service is in operation. The said sign shall not be displayed when such service is not being operated. (Please refer to paragraph 4 of the Explanatory Notes attached)
   [illegible]
7. Student Service for kindergarten or primary students operated by buses specified in this licence, whether by the licensee or by another person under a contract of hire, shall be subject to the provision of escort while the service is in operation. (This condition is applicable to a Student Service) (Please refer to paragraph 5 of the Explanatory Notes attached)
   [illegible]
8. Payment of fares of student service, except student service for post-secondary education establishments, must be collected in the form of pre-paid fares (such as coupon or monthly tickets), and no fares for one single journey being made immediately shall be collected at the boarding point(s) or on board the bus which is providing the student service. (This condition is applicable to a Student Service)
   [illegible]
9. No bus service other than those permitted by this licence shall be operated by the licensee.
   [illegible]
10. The licensee is required to comply with all conditions set out in this licence and any other licence(s) which a non-franchised bus may be subject to.
    [illegible]

Date of Issue 核發日期	

T.D.260D (Rev. 03)

Appendix IV

Household Survey



運輸署
Transport Department

CONFIDENTIAL

Please use the **number of overseas visitor tours served** as unit for answering the following questions. Please do not include the following types of tours served:

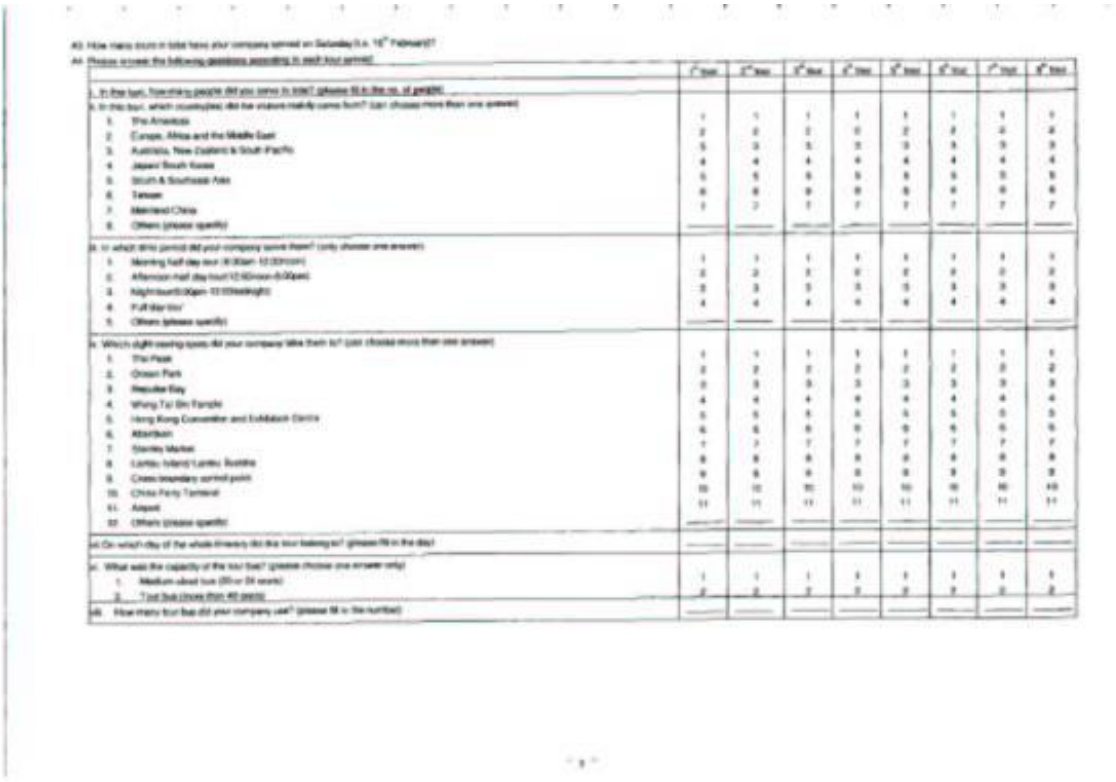
1. TOURS ONLY SERVED LOCAL PEOPLE
2. TOURS CONTRACTED OUT TO OTHER COMPANIES AND YOUR COMPANY DID NOT HAVE ANY INVOLVEMENT ON DETAILS SUCH AS TOUR ITINERARY OR TRANSPORTATION ARRANGEMENT

Please fill in the answers in the appropriate spaces. Please circle the answer for multiple choice questions.

A1. How many tours in total have your company served on 10th February?

A2. Please answer the following questions according to each tour served:

	1st tour	2nd tour	3rd tour	4th tour	5th tour	6th tour	7th tour	8th tour
a. In this tour, how many people did you serve in total? (please fill in the no. of people)								
b. In this tour, which country(ies) did the visitors mainly come from? (can choose more than one answer)								
1. The Americas	1	1	1	1	1	1	1	1
2. Europe, Africa and the Middle East	2	2	2	2	2	2	2	2
3. Australia, New Zealand & South Pacific	3	3	3	3	3	3	3	3
4. Japan/ South Korea	4	4	4	4	4	4	4	4
5. South & Southeast Asia	5	5	5	5	5	5	5	5
6. Taiwan	6	6	6	6	6	6	6	6
7. Mainland China	7	7	7	7	7	7	7	7
8. Others (please specify)								
c. In which time period did your company serve them? (only choose one answer)								
1. Morning half day tour (8:00am-12:00noon)	1	1	1	1	1	1	1	1
2. Afternoon half day tour (12:00noon-6:00pm)	2	2	2	2	2	2	2	2
3. Night tour (6:00pm-12:00midnight)	3	3	3	3	3	3	3	3
4. Full day tour	4	4	4	4	4	4	4	4
5. Others (please specify)								
d. Which sight-seeing spots did your company take them to? (can choose more than one answer)								
1. The Peak	1	1	1	1	1	1	1	1
2. Ocean Park	2	2	2	2	2	2	2	2
3. Repulse Bay	3	3	3	3	3	3	3	3
4. Wong Tai Sin Temple	4	4	4	4	4	4	4	4
5. Hong Kong Convention and Exhibition Centre	5	5	5	5	5	5	5	5
6. Aberdeen	6	6	6	6	6	6	6	6
7. Stanley Market	7	7	7	7	7	7	7	7
8. Lantau Island/ Lantau Buddha	8	8	8	8	8	8	8	8
9. Cross-boundary control point	9	9	9	9	9	9	9	9
10. China Ferry Terminal	10	10	10	10	10	10	10	10
11. Airport	11	11	11	11	11	11	11	11
12. Others (please specify)								
e. On which day of the whole itinerary did this tour belong to? (please fill in the day)								
f. What was the capacity of the tour bus? (please choose one answer only)								
1. Medium-sized bus (20 or 24 seats)	1	1	1	1	1	1	1	1
2. Tour bus (more than 40 seats)	2	2	2	2	2	2	2	2



A3. How many tours in total have your company served on Saturday (i.e. 15th February)?

A4. Please answer the following questions according to each tour served:

	1st tour	2nd tour	3rd tour	4th tour	5th tour	6th tour	7th tour	8th tour
a. In this tour, how many people did you serve in total? (please fill in the no. of people)								
b. In this tour, which country(ies) did the visitors mainly come from? (can choose more than one answer)								
1. The Americas	1	1	1	1	1	1	1	1
2. Europe, Africa and the Middle East	2	2	2	2	2	2	2	2
3. Australia, New Zealand & South Pacific	3	3	3	3	3	3	3	3
4. Japan/ South Korea	4	4	4	4	4	4	4	4
5. South & Southeast Asia	5	5	5	5	5	5	5	5
6. Taiwan	6	6	6	6	6	6	6	6
7. Mainland China	7	7	7	7	7	7	7	7
8. Others (please specify)								
c. In which time period did your company serve them? (only choose one answer)								
1. Morning half day tour (8:00am-12:00noon)	1	1	1	1	1	1	1	1
2. Afternoon half day tour (12:00noon-6:00pm)	2	2	2	2	2	2	2	2
3. Night tour (6:00pm-12:00midnight)	3	3	3	3	3	3	3	3
4. Full day tour	4	4	4	4	4	4	4	4
5. Others (please specify)								
d. Which sight-seeing spots did your company take them to? (can choose more than one answer)								
1. The Peak	1	1	1	1	1	1	1	1
2. Ocean Park	2	2	2	2	2	2	2	2
3. Repulse Bay	3	3	3	3	3	3	3	3
4. Wong Tai Sin Temple	4	4	4	4	4	4	4	4
5. Hong Kong Convention and Exhibition Centre	5	5	5	5	5	5	5	5
6. Aberdeen	6	6	6	6	6	6	6	6
7. Stanley Market	7	7	7	7	7	7	7	7
8. Lantau Island/ Lantau Buddha	8	8	8	8	8	8	8	8
9. Cross-boundary control point	9	9	9	9	9	9	9	9
10. China Ferry Terminal	10	10	10	10	10	10	10	10
11. Airport	11	11	11	11	11	11	11	11
12. Others (please specify)								
e. On which day of the whole itinerary did this tour belong to? (please fill in the day)								
f. What was the capacity of the tour bus? (please choose one answer only)								
1. Medium-sized bus (20 or 24 seats)	1	1	1	1	1	1	1	1
2. Tour bus (more than 40 seats)	2	2	2	2	2	2	2	2
g. How many tour bus did your company use? (please fill in the number)								

A5. How many tours in total have your company served on Sunday (i.e. 16th February)?

A6. Please answer the following questions according to each tour served:

	1st tour	2nd tour	3rd tour	4th tour	5th tour	6th tour	7th tour	8th tour
a. In this tour, how many people did you serve in total? (please fill in the no. of people)								
b. In this tour, which country(ies) did the visitors mainly come from? (can choose more than one answer)								
1. The Americas	1	1	1	1	1	1	1	1
2. Europe, Africa and the Middle East	2	2	2	2	2	2	2	2
3. Australia, New Zealand & South Pacific	3	3	3	3	3	3	3	3
4. Japan/ South Korea	4	4	4	4	4	4	4	4
5. South & Southeast Asia	5	5	5	5	5	5	5	5
6. Taiwan	6	6	6	6	6	6	6	6
7. Mainland China	7	7	7	7	7	7	7	7
8. Others (please specify)	____	____	____	____	____	____	____	____
c. In which time period did your company serve them? (only choose one answer)								
1. Morning half-day tour (8.30am-12.00noon)	1	1	1	1	1	1	1	1
2. Afternoon half-day tour (12.00noon-6.00pm)	2	2	2	2	2	2	2	2
3. Night tour (5.00pm-12.00midnight)	3	3	3	3	3	3	3	3
4. Full-day tour	4	4	4	4	4	4	4	4
5. Others (please specify)	____	____	____	____	____	____	____	____
d. Which sight-seeing spots did your company take them to? (can choose more than one answer)								
1. The Peak	1	1	1	1	1	1	1	1
2. Ocean Park	2	2	2	2	2	2	2	2
3. Repulse Bay	3	3	3	3	3	3	3	3
4. Wong Tai Sin Temple	4	4	4	4	4	4	4	4
5. Hong Kong Convention and Exhibition Centre	5	5	5	5	5	5	5	5
6. Aberdeen	6	6	6	6	6	6	6	6
7. Stanley Market	7	7	7	7	7	7	7	7
8. Lantau Island/ Lantau Buddha	8	8	8	8	8	8	8	8
9. Cross-boundary control point	9	9	9	9	9	9	9	9
10. China Ferry Terminal	10	10	10	10	10	10	10	10
11. Airport	11	11	11	11	11	11	11	11
12. Others (please specify)	____	____	____	____	____	____	____	____
e. On which day of the whole itinerary did this tour belong to? (please fill in the day)	____	____	____	____	____	____	____	____
f. What was the capacity of the tour bus? (please choose one answer only)								
1. Medium-sized bus (20 or 29 seats)	1	1	1	1	1	1	1	1
2. Tour bus (more than 30 seats)	2	2	2	2	2	2	2	2
g. How many tour bus did your company use? (please fill in the number)	____	____	____	____	____	____	____	____

B. Overall speaking, did your company encounter any difficulties when renting tour bus during last month? (e.g. not enough tour bus)

1. Yes
2. No

C. In the coming year, your company would expect the number of visits served by your company ...

1. Increase
2. Decrease
3. Remain unchanged

D. With reference to the current operation model of the tour bus industry, do you have any suggestion for improvement?

_____

_____

_____

_____

E. Other information

Business nature: _____

No. of employees: _____

To facilitate our follow up if there is any unclear information provided from you, grateful if you could provide the following information:

Your name: _____ Position: _____

Company name: _____ Contact Tel. No.: _____

— THANK YOU FOR YOUR COOPERATION —

Appendix V

Self-administered Survey

ACNielsen
電話： 2563 9688（ Day time ）
2880 3393（ Night time ）

Edit : _____
Check : _____
Sup. : _____

I030056 Survey on Non-Franchised Bus Patronage 2003 (Telephone Interview - Main Questionnaire)

Name of respondents : _____ Tel : _____ Tel Code : _____

Interviewer name : _____ Interviewer no. : _____

Interview date : _____ Interview time : _____

SCREENER

Good afternoon/evening ! I am _____from ACNielsen (China) Ltd., an independent marketing research agency. We are conducting a survey on non-franchised bus services on behalf of the Transport Department. Thank you for your co-operation.

How many members, including yourself, are there in your household? Household members refers to those usually living in this address, including new born baby, children, domestic helpers living at this address and those babies you/ your household members take care of on behalf of other people. Please tell me starting from the eldest.
[Interviewer: "usually" refers to at least half of the time inside a week living here]

Respondent name who answer this interview : _____

Total no. of household members : _____

Household member	01.	02.	03.	04.	05.	06.
Q1a. How old are they? 1. 0-9 2. 10-14 3. 15-19 4. 20-29 5. 30-39 6. 40-49 7. 50-59 8. 60 or above	1 2 3 4 5 6 7 8	1 2 3 4 5 6 7 8	1 2 3 4 5 6 7 8	1 2 3 4 5 6 7 8	1 2 3 4 5 6 7 8	1 2 3 4 5 6 7 8
Q1b. Sex 1. Male 2. Female	1 2	1 2	1 2	1 2	1 2	1 2
Q1c. Who is the most knowledgeable about each household member's habit in using the public transport? (Please put in a "✓" inside the box)						
Q1d. Who have taken any non-franchised bus(es) (those have 17 seats or more) in last 7 days? That is, apart from the New World First Bus, KMB, Lantau Island Bus, Citybus, Long Wing Bus, Yellow Bus and KCRC feeder buses, have you taken any non-franchised buses) (including cross boundary or local tour bus, hotel bus, school bus, company coach, resident bus and free shuttle bus such as bus for property visit or shopping) that has 17 seats or more?	1	2	3	4	5	6

List out all the household members with 15 years old or above and used non-franchised bus in the past 7 days. Please list them out from the eldest till the youngest. According to the last digit of tel code and circle the corresponding respondent.

Selected respondent : _____

List H/H Member (15 years or above)		Sex		Age	Last Digit of Telephone Code									
		M	F		1	2	3	4	5	6	7	8	9	0
Elder	1.				1	1	1	1	1	1	1	1	1	1
	2.				2	1	2	1	2	1	2	1	2	1
	3.				2	3	1	2	3	1	2	3	1	2
	4.				3	4	1	2	3	4	1	2	3	4
	5.				5	1	2	3	4	5	1	2	3	4
	6.				5	6	1	2	3	4	5	6	1	2
	7.				3	4	5	6	7	1	2	3	4	5
	8.				6	7	8	1	2	3	4	5	6	7
	9.				8	9	1	2	3	4	5	6	7	8
Youngest	10.				9	10	1	2	3	4	5	6	7	8

	1.	2.	3.	4.	5.	6.
[Interviewer record] [MA]						
1. The most knowledgeable person about each household member's habit in using the public transport	1	2	3	4	5	6
2. Respondent from Kish Grid	1	2	3	4	5	6
3. Other household members	1	2	3	4	5	6

Main questionnaire

Ask the following questions for each of the household member

Interview Date	1. ☐☐-☐☐	2. ☐☐-☐☐	3. ☐☐-☐☐	4. ☐☐-☐☐	5. ☐☐-☐☐	6. ☐☐-☐☐
Q2a. Have you taken any non-franchised bus(es) (those have 17 seats or more) in last 7 days? That is, apart from the New World First Bus, KMB, Lantau Island Bus, Citybus, Long Wing Bus, Yellow Bus and KCRC feeder buses, have you taken any non-franchised bus(es) (including cross boundary or local tour bus, hotel bus, school bus, company coach, resident bus and free shuttle bus such as bus for property visit or shopping) that has 17 seats or more? (SA) 1. Yes → Q2b 2. No → Skip to Q12	1 2	1 2	1 2	1 2	1 2	1 2
Q2b. How many trips did you make on non-franchised bus(es) in last 7 days? [Interviewer: If the respondent answered "Don't know", probe which type of non-franchised bus have you taken? What was the main purpose of taking that bus?]	___time(s)	___time(s)	___time(s)	___time(s)	___time(s)	___time(s)
Q3a. Have you taken those non-franchised bus with 17 seats or more yesterday? (i.e. ___day) (SA) 1. Yes → Q3b 2. No → Skip to Q11a	___Day 1 2	___Day 1 2	___Day 1 2	___Day 1 2	___Day 1 2	___Day 1 2
Q3b. How many trips did you make on non-franchised bus(es) yesterday? → Skip to Q4 [Interviewer: If the respondent answered "Don't know", probe which type of non-franchised bus have you taken? What was the main purpose of taking that bus?]	___time(s)	___time(s)	___time(s)	___time(s)	___time(s)	___time(s)

P.3 (Telephone Interview - Main) February 10, 2003

	1.				2.				3.				4.				5.				6.			
Q4. In the ___ trip, which type of non-franchised bus, which has 17 seats or more, did you take in the trip? (Read Out) (SA) 1.Tour bus (e.g. for local tour) 2.Hotel bus 3.School bus 4.Company coach 5.Resident bus 6.Free shuttle bus 7.Cross boundary bus (but not yellow bus) 8. Others (pls specify): _____	1st trip	2nd trip	3rd trip	4th trip	1st trip	2nd trip	3rd trip	4th trip	1st trip	2nd trip	3rd trip	4th trip	1st trip	2nd trip	3rd trip	4th trip	1st trip	2nd trip	3rd trip	4th trip	1st trip	2nd trip	3rd trip	4th trip
	01	01	01	01	01	01	01	01	01	01	01	01	01	01	01	01	01	01	01	01	01	01	01	01
	02	02	02	02	02	02	02	02	02	02	02	02	02	02	02	02	02	02	02	02	02	02	02	02
	03	03	03	03	03	03	03	03	03	03	03	03	03	03	03	03	03	03	03	03	03	03	03	03
	04	04	04	04	04	04	04	04	04	04	04	04	04	04	04	04	04	04	04	04	04	04	04	04
	05	05	05	05	05	05	05	05	05	05	05	05	05	05	05	05	05	05	05	05	05	05	05	05
	06	06	06	06	06	06	06	06	06	06	06	06	06	06	06	06	06	06	06	06	06	06	06	06
	07	07	07	07	07	07	07	07	07	07	07	07	07	07	07	07	07	07	07	07	07	07	07	07
	08	08	08	08	08	08	08	08	08	08	08	08	08	08	08	08	08	08	08	08	08	08	08	08
Q5. What was the capacity of the [read out the answer in Q4]? (Read Out) (SA) 1.Medium-sized bus (20 or 24 seats) 2.Tour bus (more than 40 seats)	1st trip	2nd trip	3rd trip	4th trip	1st trip	2nd trip	3rd trip	4th trip	1st trip	2nd trip	3rd trip	4th trip	1st trip	2nd trip	3rd trip	4th trip	1st trip	2nd trip	3rd trip	4th trip	1st trip	2nd trip	3rd trip	4th trip
	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1
	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2

P.4 (Telephone Interview - Main) February 10, 2003

		1.				2.				3.				4.				5.				6.			
Q6.	When did you take the [read out the answer in Q4]? (Read Out) (SA)	1st trip	2nd trip	3rd trip	4th trip	1st trip	2nd trip	3rd trip	4th trip	1st trip	2nd trip	3rd trip	4th trip	1st trip	2nd trip	3rd trip	4th trip	1st trip	2nd trip	3rd trip	4th trip	1st trip	2nd trip	3rd trip	4th trip
	1.Morning peak (7:00am – 10:00am)	01	01	01	01	01	01	01	01	01	01	01	01	01	01	01	01	01	01	01	01	01	01	01	01
	2.Afternoon peak (4:00pm – 7:00pm)	02	02	02	02	02	02	02	02	02	02	02	02	02	02	02	02	02	02	02	02	02	02	02	02
	3.Daytime non-peak	03	03	03	03	03	03	03	03	03	03	03	03	03	03	03	03	03	03	03	03	03	03	03	03
	4.Night time (after 7:00pm)	04	04	04	04	04	04	04	04	04	04	04	04	04	04	04	04	04	04	04	04	04	04	04	04
	5.Half day morning tour (6：00am – 12:00noon) (Only applicable for answering Q4code 1)	05	05	05	05	05	05	05	05	05	05	05	05	05	05	05	05	05	05	05	05	05	05	05	05
	6.Half day afternoon tour (12：00noon – 6:00pm) (Only applicable for answering Q4code 1)	06	06	06	06	06	06	06	06	06	06	06	06	06	06	06	06	06	06	06	06	06	06	06	06
	7.Night time tour (6：00pm – 12:00midnight) (Only applicable for answering Q4code 1)	07	07	07	07	07	07	07	07	07	07	07	07	07	07	07	07	07	07	07	07	07	07	07	07
	8. Full day tour (Only applicable for answering Q4code 1)	08	08	08	08	08	08	08	08	08	08	08	08	08	08	08	08	08	08	08	08	08	08	08	08
	9. Others (pls specify)_____ (Only applicable for answering Q4 code 1)	09	09	09	09	09	09	09	09	09	09	09	09	09	09	09	09	09	09	09	09	09	09	09	09
Q7.	What was the main purpose for you to take the [read out the answer in Q4] for that trip?	1st trip	2nd trip	3rd trip	4th trip	1st trip	2nd trip	3rd trip	4th trip	1st trip	2nd trip	3rd trip	4th trip	1st trip	2nd trip	3rd trip	4th trip	1st trip	2nd trip	3rd trip	4th trip	1st trip	2nd trip	3rd trip	4th trip
	1. Work related purposes (including going to/ from work, business trip, meeting)	01	01	01	01	01	01	01	01	01	01	01	01	01	01	01	01	01	01	01	01	01	01	01	01
	2.Study related purposes (including going to/ from school)	02	02	02	02	02	02	02	02	02	02	02	02	02	02	02	02	02	02	02	02	02	02	02	02
	3.Social purposes (e.g. visiting friends/ relatives)	03	03	03	03	03	03	03	03	03	03	03	03	03	03	03	03	03	03	03	03	03	03	03	03
	4.Recreational/ Sports/ cultural purposes	04	04	04	04	04	04	04	04	04	04	04	04	04	04	04	04	04	04	04	04	04	04	04	04
	5.Personal purposes (e.g. dine out, going to private tutorial school)	05	05	05	05	05	05	05	05	05	05	05	05	05	05	05	05	05	05	05	05	05	05	05	05
	6. Others (pls specify) _____	06	06	06	06	06	06	06	06	06	06	06	06	06	06	06	06	06	06	06	06	06	06	06	06

P5 (Telephone Interview - Main) February 10, 2003

		1.				2.				3.				4.				5.				6.			
Q8.	What was the reason(s) for you to take the [read out the answer in Q4] in that trip? [MA]	1st trip	2nd trip	3rd trip	4th trip	1st trip	2nd trip	3rd trip	4th trip	1st trip	2nd trip	3rd trip	4th trip	1st trip	2nd trip	3rd trip	4th trip	1st trip	2nd trip	3rd trip	4th trip	1st trip	2nd trip	3rd trip	4th trip
	1.Speedy	01	01	01	01	01	01	01	01	01	01	01	01	01	01	01	01	01	01	01	01	01	01	01	01
	2.Comfortable	02	02	02	02	02	02	02	02	02	02	02	02	02	02	02	02	02	02	02	02	02	02	02	02
	3.Free of charge	03	03	03	03	03	03	03	03	03	03	03	03	03	03	03	03	03	03	03	03	03	03	03	03
	4.Staff benefits	04	04	04	04	04	04	04	04	04	04	04	04	04	04	04	04	04	04	04	04	04	04	04	04
	5.Traveling	05	05	05	05	05	05	05	05	05	05	05	05	05	05	05	05	05	05	05	05	05	05	05	05
	6.No other public vehicles nearby	06	06	06	06	06	06	06	06	06	06	06	06	06	06	06	06	06	06	06	06	06	06	06	06
	7.Cheaper/ have discounts	07	07	07	07	07	07	07	07	07	07	07	07	07	07	07	07	07	07	07	07	07	07	07	07
	8.Property visit/ shopping	08	08	08	08	08	08	08	08	08	08	08	08	08	08	08	08	08	08	08	08	08	08	08	08
	9.Convenient (directly to the destination)	09	09	09	09	09	09	09	09	09	09	09	09	09	09	09	09	09	09	09	09	09	09	09	09
	10. Safe	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10
	11. Accustomed to it	11	11	11	11	11	11	11	11	11	11	11	11	11	11	11	11	11	11	11	11	11	11	11	11
	12. Others (pls specify)_____	12	12	12	12	12	12	12	12	12	12	12	12	12	12	12	12	12	12	12	12	12	12	12	12
	13. Others (pls specify)_____	13	13	13	13	13	13	13	13	13	13	13	13	13	13	13	13	13	13	13	13	13	13	13	13
	14. Others (pls specify)_____	14	14	14	14	14	14	14	14	14	14	14	14	14	14	14	14	14	14	14	14	14	14	14	14
	15. Others (pls specify)_____	15	15	15	15	15	15	15	15	15	15	15	15	15	15	15	15	15	15	15	15	15	15	15	15
Q9a.	Did you need to pay for the [read out the answer in Q4] in that trip? (including tickets provided by company or living area) (SA)	1st trip	2nd trip	3rd trip	4th trip	1st trip	2nd trip	3rd trip	4th trip	1st trip	2nd trip	3rd trip	4th trip	1st trip	2nd trip	3rd trip	4th trip	1st trip	2nd trip	3rd trip	4th trip	1st trip	2nd trip	3rd trip	4th trip
	1.Yes→ Skip to Q9b	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1
	2.No→ Skip to Q10	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2

P6 (Telephone Interview - Main) February 10, 2003

	1.				2.				3.				4.				5.				6.			
Q9b. Did you pay each time or pay tickets for the [read out the answer in Q4] in that trip? (SA)	1st trip	2nd trip	3rd trip	4th trip	1st trip	2nd trip	3rd trip	4th trip	1st trip	2nd trip	3rd trip	4th trip	1st trip	2nd trip	3rd trip	4th trip	1st trip	2nd trip	3rd trip	4th trip	1st trip	2nd trip	3rd trip	4th trip
1. Pay each time 2. Pay ticket 3. Monthly payment (e.g. school bus pass)	1 2 3	1 2 3	1 2 3	1 2 3	1 2 3	1 2 3	1 2 3	1 2 3	1 2 3	1 2 3	1 2 3	1 2 3	1 2 3	1 2 3	1 2 3	1 2 3	1 2 3	1 2 3	1 2 3	1 2 3	1 2 3	1 2 3	1 2 3	1 2 3
Q10. Did the driver of the [read out the answer in Q4] follow the fixed journey in that trip? (SA)	1st trip	2nd trip	3rd trip	4th trip	1st trip	2nd trip	3rd trip	4th trip	1st trip	2nd trip	3rd trip	4th trip	1st trip	2nd trip	3rd trip	4th trip	1st trip	2nd trip	3rd trip	4th trip	1st trip	2nd trip	3rd trip	4th trip
1.Yes 2.No 3.Not applicable (not applicable for Q4code 5)	1 2 3	1 2 3	1 2 3	1 2 3	1 2 3	1 2 3	1 2 3	1 2 3	1 2 3	1 2 3	1 2 3	1 2 3	1 2 3	1 2 3	1 2 3	1 2 3	1 2 3	1 2 3	1 2 3	1 2 3	1 2 3	1 2 3	1 2 3	1 2 3
[Interviewer: According to the tel. code to select: If the tel. code is 1-5, please ask "Saturday"; if the tel. code is 6-0, please ask "Sunday"]																								
Q11a. Have you taken those non-franchised bus in the past Saturday/ Sunday? (SA) **[If yesterday equals the selected day, no need to ask Q11a-c & circle Not Applicable]** [Interviewer: If the respondent answered "No", probe: Have you taken cross boundary or local tour bus, hotel bus, school bus, company coach, resident bus and free shuttle bus such as bus for property visit or shopping in the past Saturday/ Sunday?] 1. Yes 2. No→ Skip to Q12 3. Not applicable	1 2 3				1 2 3				1 2 3				1 2 3				1 2 3				1 2 3			

	1.				2.				3.				4.				5.				6.			
Q11b. How many trips did you make on non-franchised bus(es) that day? [Interviewer: If the respondent answered "Don't know", probe which type of non-franchised bus have you taken? What was the main purpose of taking that bus?]	___ time(s)				___ time(s)				___ time(s)				___ time(s)				___ time(s)				___ time(s)			
Q11c. In the ___ trip, which type of non-franchised bus, which has 17 seats or more, did you take in the trip? (Read Out) (SA)	1st trip	2nd trip	3rd trip	4th trip	1st trip	2nd trip	3rd trip	4th trip	1st trip	2nd trip	3rd trip	4th trip	1st trip	2nd trip	3rd trip	4th trip	1st trip	2nd trip	3rd trip	4th trip	1st trip	2nd trip	3rd trip	4th trip
1.Tour bus 2.Hotel bus 3.School bus 4.Company coach 5.Resident bus 6.Free shuttle bus 7.Cross boundary bus (not yellow bus) 8. Others (pls specify)________	01 02 03 04 05 06 07 08	01 02 03 04 05 06 07 08	01 02 03 04 05 06 07 08	01 02 03 04 05 06 07 08	01 02 03 04 05 06 07 08	01 02 03 04 05 06 07 08	01 02 03 04 05 06 07 08	01 02 03 04 05 06 07 08	01 02 03 04 05 06 07 08	01 02 03 04 05 06 07 08	01 02 03 04 05 06 07 08	01 02 03 04 05 06 07 08	01 02 03 04 05 06 07 08	01 02 03 04 05 06 07 08	01 02 03 04 05 06 07 08	01 02 03 04 05 06 07 08	01 02 03 04 05 06 07 08	01 02 03 04 05 06 07 08	01 02 03 04 05 06 07 08	01 02 03 04 05 06 07 08	01 02 03 04 05 06 07 08	01 02 03 04 05 06 07 08	01 02 03 04 05 06 07 08	01 02 03 04 05 06 07 08
Q12. Will you expect an increase or decrease in frequency of taking those non-franchised bus(es) in the coming 12 months? (SA) 1.Increase 2.Decrease 3.Remain the same	1 2 3				1 2 3				1 2 3				1 2 3				1 2 3				1 2 3			

	1.	2.	3.	4.	5.	6.
Q13a. Are you currently work full time job or part time job? (If "no", then are you [read out code 03-05]?						
01. Full time	01	01	01	01	01	01
02. Part time	02	02	02	02	02	02
03. Non working – student → Q13b	03	03	03	03	03	03
04. Non working – housewife	04	04	04	04	04	04
05. Non working – unemployed	05	05	05	05	05	05
06. Non working – retired	06	06	06	06	06	06
07. Others (pls specify):_____	07	07	07	07	07	07
Q13b. Which level are you studying? (Read Out)						
1. Kindergarten	1	1	1	1	1	1
2. Primary school	2	2	2	2	2	2
3. Secondary school	3	3	3	3	3	3
4. Matriculated or above	4	4	4	4	4	4

[Continue for respondent selected from Kish Grid random table, otherwise skip to Q17 for the most knowledgeable person about each household member's habit in using the public transport. For all others, read out – *Then, I would like to interview your other household members, can I talk to them?*

[Repeat the introduction and ask Q2 to Q13b, until all household members were asked about their travel pattern on non-franchised bus yesterday]

Only interview respondent from Kish Grid table	1.	2.	3.	4.	5.	6.
Q14a. For those non-franchised buses which you take most often, are you satisfied with their services in terms of the following aspects? (Please use a 5-point scale to rate the service attributes; 5 points mean very satisfied, 4-quite satisfied, 3-average, 2-quite dissatisfied and 1-very dissatisfied)						
a) Cleanliness of bus interior	_____	_____	_____	_____	_____	_____
b) Condition of the bus	_____	_____	_____	_____	_____	_____
c) Safety – driving skills	_____	_____	_____	_____	_____	_____
d) Facilities (e.g. air-conditioning, seats)	_____	_____	_____	_____	_____	_____
Q14b. Overall speaking, how satisfied are you with the services provided by the non-franchised bus(es)? (Please use a 5-point scale to rate the service attributes; 5 points mean very satisfied, 4-quite satisfied, 3-average, 2-quite dissatisfied and 1-very dissatisfied)	_____	_____	_____	_____	_____	_____

Only interview respondent from Kish Grid table	1.	2.	3.	4.	5.	6.
Q15a. Have you ever taken the non-franchised bus(es) which has installed a TV set? (SA) 1. Yes → Q15b 2. No → Q16	1 2	1 2	1 2	1 2	1 2	1 2
Q15b. Which type of non-franchised bus? (MA) 1.Tour bus 2.Hotel bus 3.School bus 4.Company coach 5.Resident bus 6.Free shuttle bus 7.Cross boundary bus (not yellow bus) 8. Others (pls specify):_____	01 02 03 04 05 06 07 08	01 02 03 04 05 06 07 08	01 02 03 04 05 06 07 08	01 02 03 04 05 06 07 08	01 02 03 04 05 06 07 08	01 02 03 04 05 06 07 08
Q16. Do you agree or disagree with that, to install TV set in non-franchised buses? (SA) 1.Agree 2.Disagree 3.Neutral	1 2 3	1 2 3	1 2 3	1 2 3	1 2 3	1 2 3

If the respondent is not the most knowledgeable person, find the most knowledgeable person to continue asking Q17; otherwise continue Q17.

Q17. Which district are you living in? [Read Out] (SA)

Hong Kong Island		Kowloon		New Territories	
Central	01	Yau Tsim Mong	06	Tsuen Wan	11
Western district	02	Sham Shui Po	07	Kwai Tsing	12
Wanchai	03	Kowloon City	08	Tuen Mun	13
Eastern district	04	Wong Tai Sin	09	Yuen Long	14
Southern district	05	Kwun Tong	10	Northern district	15
				Tai Po	16
				Shatin	17
				Sai Kung	18
				Islands	19

Q18. What is your monthly household income?

Below $10,000	1
$10,000 - $19,999	2
$20,000 - $29,999	3
$30,000 - $39,999	4
$40,000 - $49,999	5
$50,000 or above	6

[To interview respondent from Kish Grid] [Read Out]
Next, I would like to interview other household members. Can I talk to [Read out the selected respondent from Kish Grid table]?
(If the selected respondent is not at home, arrange an interview for another date and time.)
[Repeat the introduction and ask Q2 to Q15]

[To interview the most knowledgeable person about each household member's habit in using the public transport] [Read out]
Then, I would like to interview your household members. Can I talk to [Read out the most knowledgeable person]?
(If the sampled respondent is not at home, arrange an interview for another date and time.)
[Repeat the introduction and ask Q2 to Q15]

[Continue to invite other household members. If rejected, repeat the purpose of conducting the survey. If rejected again, invite the most knowledgeable person to answer for the others.]

— Thank you for your co-operation —

Appendix VI

Estimation Procedures for Taxi Stand Survey

Let y_{hij} be the waiting time of the jth passenger or taxi at the ith taxi stand in the hth stratum.

Let x_{hij} be the jth passenger or taxi at the ith taxi stand in the hth stratum (count of elements)

(i) Individual Taxi Stand

The average waiting time at the ith taxi in the hth stratum becomes

$$y_{hi} = \frac{\sum_j y_{hij}}{\sum_j x_{hij}} = \frac{y_{hi}}{x_{hi}} \quad \ldots\ldots\ldots\ldots \quad (1)$$

where $y_{hi} = \sum_j^{J_i} y_{hij}$ = Total waiting time of all passengers or taxis at the ith taxi stand in the hth stratum

$x_{hi} = \sum_j^{J_i} x_{hij}$ = Total no. of passengers or taxi at the ith taxi stand in the hth stratum

= Total count of elements at the ith taxi stand in the hth stratum

(ii) Stratum

The mean for the hth stratum can be obtained as follows :

$$y_h = \frac{\sum\sum y_{hij}}{\sum\sum x_{hij}} = \frac{y_h}{x_h} \quad \ldots\ldots\ldots\ldots \quad (2)$$

and var (y_h) becomes

$$\text{var}(y_h) = \frac{1 - f_h}{x_h^2} \cdot \frac{a_h}{a_h - 1} \left(\sum y_{hi}^2 + y_h^2 \sum x_{hi}^2 - 2y_h \sum y_{hi} \cdot x_{hi}\right) \quad \ldots\ldots\ldots\ldots \quad (3)$$

where f_h = sampling fraction in the hth stratum

$$= \frac{\text{No. of clusters}^{\#} \text{ selected in the } h\text{th stratum}}{\text{Total no. of clusters in the } h\text{th stratum}}$$

a_h = No. of clusters selected in the hth stratum

$^{\#}$ Cluster refers to taxi stand

(iii) Area

For each area, the sample can be regarded as being selected from two strata, viz. active and moderate, with a higher sampling rate of the taxi stand and hence passengers or taxis from the active group. To compensate for the unequal probability of selection of elements in various strata, the observed values should be properly weighted by the inverse of the selection probability :

$$y'_{hij} = \frac{1}{p_h} y_{hij} \quad \text{.....(4)}$$

$$x'_{hij} = \frac{1}{p_h} x_{hij} \quad \text{.....(5)}$$

Substituting the respective h for each of the area, the average waiting time for the respective areas is given as :

$$r = \frac{y'}{x'} = \frac{\sum_h \sum_i y'_{hi}}{\sum_h \sum_i x'_{hi}} = \frac{\sum_i y'_h}{\sum_i x'_h} \quad \text{.....} \quad (6)$$

If f_h denotes the sampling fraction and a_h denotes the number of clusters in the hth stratum, then the variance or r becomes

$$\text{var}(r) = \frac{1}{x'^2} \left\{ \sum_h \text{var}(y'_h) + r^2 \sum_h \text{var}(x'_h) - 2r \sum_h \text{cov}(y'_h x'_h) \right\}$$

$$= \frac{1}{x'^2} \left\{ \sum_h d^2 y'_h + r^2 \sum_h d^2 x'_h - 2r \sum_h d y'_h d x'_h \right\} \quad \text{.....} \quad (7)$$

where $d^2 y'_h = \frac{(1-f_h)}{a_h - 1} \left(a_h \sum_i y'^2_{hi} - y'^2_h \right)$

$$d^2 x'_h = \frac{(1-f_h)}{a_h - 1} \left(a_h \sum_i x'^2_{hi} - x'^2_h \right)$$

$$dy'_h dx'_h = \frac{(1-f_h)}{a_h - 1} \left(a_h \sum_i y'_{hi} x'_{hi} - y'_h x'_h \right)$$

(iv) Territory

Using the sample design adopted, the average waiting time for the Territory and its variance are given by equation (6) and (7) respectively. In this case, observations pertaining to all the strata would be incorporated in the derivation of the average waiting time and its variance.

Appendix VII

Procedures for Selection of Sites for Roadside Observation Survey

Steps

1. Find out the kilometres of each road section in the stratum.

2. List the road section in alphabetical order then append a cumulative total of the road length to this list.

3. Determine the selection interval I by dividing the total length B_k of all road section by the number of sites b_k to be selected.

4. Draw a random number RS between zero and the selection interval and thus arrive at a set of selection numbers, i.e. $RS + nI$ where $n = 0, 1, 2 \ldots, b_k - 1$.

5. Select those road sections with cumulative road length corresponding to these selection numbers.

Appendix VIII

Estimation Procedures for Roadside Observation Survey

In the case of measuring taxi utilization in terms of the proportion of occupied taxis.

Let y_{hij} = $\begin{cases} 1 \text{ if the } j\text{th taxi is occupied} \\ 0 \text{ if the } j\text{th taxi is not occupied} \end{cases}$

x_{hij} be the jth taxi passing through the ith site in the hth stratum (count of elements)

To obtain the mean vacant taxi headway as an indicator or taxi availability,

Let y_{hij} be the length of the jth interval between successive vacant taxis at the ith site in the hth stratum

x_{hij} be the jth interval between successive vacant taxis at the ith site in the hth stratum (count of elements)

(i) Individual Site

The mean is given as :

$$\dot{y}_{hi} = \frac{\Sigma y_{hij}}{\Sigma x_{hij}} = \frac{y_{hi}}{x_{hi}}$$

(ii) Stratum

The probability of selection for each road link in a hth stratum, p_h, is given as follows :-

$$p_h = \frac{\text{Length of road link x No. of road link to be selected in } h\text{th stratum}}{\text{Total length of road links in } h\text{th stratum}}$$

Thus the observed values y_{hij} and x_{hij} have to be compensated by proper weighting as in equations for estimating the mean and its variance for each stratum are then as the same as given in equations (2) and (3) of Appendix VI respectively.

(iii) Area

The formulae for estimating the mean and its variance for each area are the same as given in equations (6) and (7) of Appendix VI respectively when substituting the respective h for each of the area. Since there does not exits a uniform f_h for each stratum, the factor $1-f_h$ is undetermined and thus ignored for approximation.

(iv) Territory

The estimates of the territory-wide mean/proportion and its variance can be obtained by substituting the weighted observed values from all the strata into equations (6) and (7) of Appendix VI respectively.

Appendix IX

Appendix IX

填入數據後即成限閱文件
只有獲授權人士可閱讀本文件內容

運輸署2005年度市區的士營業開支調查
請填寫2005年1月份至12月份(即1月1日至12月31日)之資料

(一) 請即填妥本問卷，用附上的回郵信封（郵費已付）寄回：
香港灣仔告士打道7號
入境事務大樓40字樓4036室
運輸署渡輪及輔助客運部

(二) 如有疑問，請電：
羅家勤先生 2829 5808
李景旋先生 2829 5318

(三) 請注意，你所填報的資料將會保密及只作整體統計分析用途，而分析結果只會在交通及運輸事務上作參考之用。問卷會於分析完成後全部銷毀。

此欄不用填寫

填報者姓名： [4]

聯絡電話： [10]

日期： [11]

I 填報年度

2005 年度(即 2005 年 1 月份至 12 月份) 經營日期爲：

_____月 _____日至_____月____日

II 經營狀況

請根據期內主要(即時間最長的一種)經營狀況提供資料。

1. 你的的士主要服務區域是：
   - ☐ 香港島
   - ☐ 九龍及沙田
   - ☐ 新界西(荃灣,葵涌及青衣)
   - ☐ 新界西(元朗,天水圍及屯門)
   - ☐ 新界東(馬鞍山,大埔,北區及西貢)
   - ☐ 機場

2. 你的的士平均每月的經營日數爲 _____日

III 經營費用 (如費用由司機負責，請向司機查詢後填寫。如以兩更制經營，請填寫兩更的總費用)

1. 石油氣 (每日____更, 每更共$_____) 1.$_____每日
2. 燃油及啤油 2.$_____全年
3. 輪胎 (每年共換_____對, 每對共$_____) 3.$_____全年
4. 電池 (每_____月更換一個, 每個共$_____) 4.$_____全年
5. 其他維修 (包括「大驗」、「小驗」及日常零件修理) 5.$_____全年
6. 全年汽車保險 (請扣除保險公司給予車主的折扣) 6.$_____全年
7. 商會/工會會費及的士台台費 (不包括「郵政司費」) 7. 有☐ 沒有☐ $_____全年
8. 司機勞工保險 8. 有☐ 沒有☐ $_____全年
9. 泊車費 (包括使用車位與停車收費錶的費用) 9. 有☐ 沒有☐ $_____每月
10. 清潔費 (自己打掃則毋須填報) 10.有☐ 沒有☐ $_____每月
11. 行政費用 (例如：寫字樓租金及職員薪金。只計算與的士日常營運有關的費用，並就所擁有的的士平均計算) 11.有☐ 沒有☐ $_____每月

請註明 _____

IV 商會/工會會員

1. 請根據所屬的士商會/工會於下表填上 √

IV.1 [ ][ ][80]

- ☐ 沒有
- ☐ 1.全利電召的士聯會
- ☐ 2.城市的士車主司機聯會
- ☐ 3.友聯的士車主聯誼會
- ☐ 4.車馬樂的士聯會
- ☐ 5.港九電召的士車主聯會
- ☐ 6.港九利來無線電召車中心
- ☐ 7.香港九龍的士貨車商會
- ☐ 8.香港的士小巴商總會
- ☐ 9.九龍的士車主聯會
- ☐ 10.汽車交通運輸業總工會
- ☐ 11.百佳的士車主聯會
- ☐ 12.四海的士車主司機聯會
- ☐ 13.環保的士車主聯會
- ☐ 14.的士權益協會
- ☐ 15.豪華優質的士電召聯會
- ☐ 16.泰和車行
- ☐ 17.的士司機從業員總會
- ☐ 18.的士同業聯會
- ☐ 19.港聯的士車主聯會
- ☐ 20.交通事業從業員協會
- ☐ 21.聯友的士同業聯會
- ☐ 22.市區的士司機聯委會
- ☐ 23.偉發的士車主聯會
- ☐ 24.惠益港九及新界的士車主聯會
- ☐ 25.榮利無線電車商會
- ☐ 26.榮泰車主及司機聯會
- ☐ 27.香港計程車會
- ☐ 28.忠誠車行
- ☐ 29.其他

2. 請根據所屬的士無線電召公司(即電召台)於下表填上 √

IV.2 [ ][ ][82]

- ☐ 沒有
- ☐ 1.全利電召的士聯會
- ☐ 2.城市的士車主司機聯會
- ☐ 3.友聯的士車主聯誼會
- ☐ 4.車馬樂的士聯會
- ☐ 5.港九電召的士車主聯會
- ☐ 6.港九利來無線電召車中心
- ☐ 7.香港九龍的士貨車商會
- ☐ 8.香港的士小巴商總會
- ☐ 9.九龍的士車主聯會
- ☐ 10.汽車交通運輸業總工會
- ☐ 11.百佳的士車主聯會
- ☐ 12.四海的士車主司機聯會
- ☐ 13.環保的士車主聯會
- ☐ 14.的士權益協會
- ☐ 15.豪華優質的士電召聯會
- ☐ 16.泰和車行
- ☐ 17.的士司機從業員總會
- ☐ 18.的士同業聯會
- ☐ 19.港聯的士車主聯會
- ☐ 20.交通事業從業員協會
- ☐ 21.聯友的士同業聯會
- ☐ 22.市區的士司機聯委會
- ☐ 23.偉發的士車主聯會
- ☐ 24.惠益港九及新界的士車主聯會
- ☐ 25.榮利無線電車商會
- ☐ 26.榮泰車主及司機聯會
- ☐ 27.香港計程車會
- ☐ 28.忠誠車行
- ☐ 29.其他

V 經營制度

請根據期內主要(即時間最長的一種)經營制度提供資料。

V. [ ][83]

- ☐ 全日一更(「特更」)制
  請繼續填寫 「黃紙」
- ☐ 早夜兩更制
  請繼續填寫 「紅紙」

全日一更(「特更」)制

1. 你的的士主要經營時間爲　　通常由上午____時____分
起至下午____時____分止

2. 你的的士由誰人駕駛
☐ (i)車主或其配偶

☐ (ii)租給司機
特別更租金--每更 $_____
每月租金 $_____

☐ (iii)僱用有底薪的司機
a. 司機每更的底薪　　每更 $_____

b. 司機每更首筆無權分紅的收入(「圍數」)　　每更 $_____

c. 除首筆無權分紅的收入(「圍數」)外，司機分賬的百分比爲　　_____%

d. 司機其他收入(例如花紅、年尾雙糧等)　　平均每月 $_____
請註明：

☐ (iv) 分賬(無底薪)的司機
每名司機每更可分賬的百分比爲　　_____%

3. 平均每月的士車身廣告收入　　$_____

早夜兩更制

1. 你的的士主要經營時間爲

早更 通常由上午___時____分
起至下午____時___分止
夜更 通常由下午___時____分
起至晚上/凌晨___時___分止

1a [124] 1b [128] 1c [132] 1d [136]

2. 你的的士由誰人駕駛

☐ (i)車主或其配偶

早更 ☐
夜更 ☐

2(i) [138]

☐ (ii)租給司機

早更 ☐
早更租金--每更 $_____
每月租金 $_____

夜更 ☐
夜更租金--每更 $_____
每月租金 $_____

2(ii)a [141] [146]

2(ii)b [149] [154]

☐ (iii)備用有底薪的司機

a. 司機每更的底薪 每更 $_____

b. 司機每更首筆無權分紅的收入(「圍數」) 每更 $_____

c. 除首筆無權分紅的收入(「圍數」)外、司機分賬的百分比爲 _____%

d. 司機其他收入(例如花紅、年尾雙糧等) 平均每月 $_____
請註明：

2(iii)a [157] 2(iii)b [160] 2(iii)c [162] 2(iii)d [166]

☐ (iv) 分賬(無底薪)的司機
每名司機每更可分賬的百分比爲 _____%

2(iv) [168]

3. 平均每月的士車身廣告收入 $_____

3 [173] SC [178]

- 問卷完，多謝合作。-

附錄

市區的士商會和無線電召公司名單

1. 友聯的士車主聯誼會
2. 港九的士總商會
3. 香港九龍的士貨車商會有限公司
4. 九龍的士車主聯會有限公司
5. 汽車交通運輸業總工會
6. 的士同業聯會有限公司
7. 惠益港九及新界的士車主聯誼會
8. 榮利無線電車商會有限公司
9. 的士權益(四海)電召有限公司
10. 港九電召的士車主聯會有限公司
11. 聯友的士同業總會
12. 益新電召客車聯會
13. 交通事業從員協會
14. 偉發的士車主聯會有限公司
15. 聯合無線電的士貨車聯會
16. 港九利萊無線電召車中心有限公司
17. 車馬樂的士聯會有限公司
18. 市區的士司機聯委會有限公司
19. 全通 / 全利電召的士聯會有限公司
20. 榮泰車主司機聯會有限公司
21. 城市的士車主司機聯會有限公司
22. 百佳的士車主聯會有限公司
23. 香港的士中心
24. 環保的士車主聯會有限公司

25. 的士司機從業員總會有限公司

26. 港聯的士車主聯會有限公司

27. 的士商會聯盟

28. 香港的士小巴商總會有限公司

Appendix X

Appendix X

Sample Form

運輸署———市區的士咪錶讀數調查(2002-2003)

此欄無須填寫

咪錶型號：

☐ .. Patent III
☐ .. Patent V
☐ .. Patent VI
☐ .. Patent VIP
☐ .. SJQ-06A
☐ .. TH-2010PV
☐ .. Toyo TC-2003
☐ .. Toyo TC-2003AT
☐ ..Takery VI
☐ ..Takery 787-C
☐ ..Takery 787-CP
☐ ..Takery 787-RV
☐ ..Toyo TC-2001
☐ ..Toyo TC-2002
☐ ..Toyo TC-2003AP
☐ ..其他：_____

Centre Code : _____
Serial Code: _____
S/N: ☐☐☐☐ 1-4
Reg: ☐☐☐☐☐☐ 5-10
D/H ☐☐☐☐ 11-14

車輛登記號碼：_____ 司機姓名：_____ 司機聯絡電話：_____ 車主聯絡電話：_____

A欄：咪錶讀數調查
由司機填報下列資料：請於第二天至第七天期間內每日開始工作前記錄下列資料
（備註：該欄由運輸署委派代表在的士咪錶站記錄）

	日期		記錄咪錶度數時間									
	月	日		時	分	1	2	3	4	5	6	7	8
#1			上午 下午										
2			上午 下午										
3			上午 下午										
4			上午 下午										
5			上午 下午										
6			上午 下午										
7			上午 下午										
#8			上午 下午										
此欄由本署填寫													

Pkm ☐☐☐☐ 15-18
Tkm ☐☐☐☐ 19-22
Tr ☐☐☐ 23-25
Un ☐☐☐☐ 26-29
Sh. ☐ 30
Op ☐☐ 32
Tips ☐☐☐ 33-35
lugg ☐☐ 36-37
Cal ☐☐ 38-39

B 欄：雜項收入調查

1. 你所駕駛之的士採用：
   2002年度
   ☐.. 全日一更（"特更"）制
   ☐.. 兩更制
   2003年3月
   ☐.. 全日一更（"特更"）制
   ☐.. 兩更制

2a. 如行一更("特更")制，你採用何種方式經營？
   2002年度
   ☐.. 車主或其配偶
   ☐.. 被僱用
   ☐.. 分賬
   ☐.. 租車
   2003年3月
   ☐.. 車主或其配偶
   ☐.. 被僱用
   ☐.. 分賬
   ☐.. 租車

2b. 如行二更制，
   上更採用何種方式經營？
   2002年度
   ☐.. 車主或其配偶
   ☐.. 被僱用
   ☐.. 分賬
   ☐.. 租車
   下更採用何種方式經營？
   ☐.. 車主或其配偶
   ☐.. 被僱用
   ☐.. 分賬
   ☐.. 租車
   2003年3月
   ☐.. 車主或其配偶
   ☐.. 被僱用
   ☐.. 分賬
   ☐.. 租車
   ☐.. 車主或其配偶
   ☐.. 被僱用
   ☐.. 分賬
   ☐.. 租車

(供租車司機填報)

B 欄：雜項支出調查

1. 除車租及燃料等主要支出外，你平均每月的雜項支出（如定額罰款，由司機負責的輕微維修費用等），2002年度約爲_____元，而2003年3月約爲_____元。
2. 你平均每月租車更數，2002年度約爲_____更，而2003年3月約爲_____更。
3. 你平均每月租車駕駛，2002年度約爲_____日，而2003年3月約爲_____日。

3. 你平均每更獲"點士"，2002年度約爲_____元，而2003年3月約爲_____元。
4. 你平均每更接載，2002年度約爲_____件行李，而2003年3月約爲_____件行李。
5. 你平均每更，2002年度可獲_____元電召服務費，而2003年3月可獲_____元電召服務費。

Appendix XI

T.P.D.M.V.8.5

Appendix XI

Sample Form for Sundry Income Survey

Taximeter Reading and Sundry Income Surveys 2003

Interview Survey on Alighting Taxi Passenger

調查員
Survey Taken by : _____

位置
Location : _____ (市區 / 新界 / 大嶼山) (Urban / N.T. / Lantau)

日期及星期
Date & Day : _____ 天氣 Weather : _____ 晴天 / 陰天 / 雨天 Sunny / Cloudy / Rainy

Time 時間		Taxi Fare 車資 $	Tips (if any) 小費 (如有) $	No. of chargeable luggage (if any) 收取行李附加費的行李數目 (如有)	Radio-call Surcharge (Yes or No) 電召附加費 (是 / 否)	Tunnel fee (if any) 隧道費 (如有) $	Tunnel surcharge 隧道回程費 $	Taxi Type (U/NT/L) 的士類別 (市區/新界/大嶼山)

Appendix XII

Appendix XII

Sample Form for Surveyor's Record of the Survey
Taxi Meter reading Survey 2002-2003

Surveyor Record Sheet

Centre Code : _____ Date & Day : _____ Reading : 1st/2n

Serial No.	Reg. No.	Time	Meter* Type Code	1	2	3	4	5	6	7	8	Name	Driver Tel. No	Owner Tel. No

Meter Type Code :

Takery	Patent	Others	Toyo
TVI - Takery VI	PIII - Patent III	SJQ - SJQ-06A	Y01 – TC-2001
T87 - Takery 787	PV - Patent V	TH – 2010PV	Y02 - TC-2002
Tc - Takery 787-CP	PVI - Patent VI		Y03 - TC-2003
Tcp - Takery 787-RV	PVIP – Patent VIP		YAP - TC-2003 AP
			YAT – TC-2003 AT

6.1 References

1. Wilbur Smith and Associates Ltd. (1976) *Hong Kong Comprehensive Transport Study Final Report*, HKSAR

2. Transport Department (1981) *TTSD Technical Report No.319, Special Surveys on Transport Characteristics* , HKSAR

3. Transport Department *Transport Planning and Design Manual* Volume 8, Chapter 1, HKSAR

4. MVA Asia Ltd (1992) *Final Report on Travel Characteristics Survey*, HKSAR

5. Wilbur Smith Associates Ltd. (1989) *The Second Comprehensive Transport Study*, HKSAR

6. Richardson , Ampt and Meyburg, Eucalptus Press (1995) *Surveys Methods for Transport Planning*

7. Wilbur Smith Associates Ltd. (1999) *The Third Comprehensive Transport Study*, HKSAR

8. Ove Arup & Partners Hong Kong Ltd. *Final Report on Travel Characteristics Survey 2002*, HKSAR

9. Ove Arup & Partners Hong Kong Ltd. *Final Report and Technical Report on Travel Characteristics Survey 2011*, HKSAR

10. Ove Arup & Partners Hong Kong Ltd. *Final Report and Technical Report on Travel Characteristics Survey 2022*, HKSAR

11. Department of Transportation, Federal Highway Administration *National Household Travel Survey*, U.S

12. Department of Transport *National Travel Survey*, U.K

6.2 Introduction

6.2.1 Home interview is a data collection methodology by which enumerators contact respondents at their place of residence on a personal basis and obtain the information required. Traditionally, a questionnaire will be used to record the information to be collected.

6.2.2 Home interview survey is often large in scale. Detailed and comprehensive planning work is required for the office and field operation. A substantial amount of professional input is therefore required for the planning and implementation of a home interview survey. As the Census & Statistics Department (C&SD) is the expert in conducting home interview survey, they should be consulted on all aspects of the home interview survey being planned. In particular, the C&SD may be approached for professional assistance in the field operation.

6.2.3 In the past five decades, six large-scale home interview surveys on Hong Kong residents' travel characteristics have been conducted to collect the household travel characteristics data for subsequent enhancement of the Comprehensive Transport Study Model (CTS Model), which is a key transport planning tool. The first home interview survey conducted for transport planning purpose is the Home Interview Surveys conducted in 1973 for the Hong Kong Comprehensive Transport Study.

6.2.4 In 1981, another extensive home interview survey, the 1981 Special Surveys on Transport Characteristics, was conducted to obtain more up-to-date information so as to enable the CTS models developed in 1976 to be updated and re-calibrated. In 1992, 2002, 2011 and 2022, the Travel Characteristics Surveys (TCSs) were conducted in order to update and re-calibrate the CTS Model. Consultants were commissioned to design, manage and analyse the data and information collected in TCSs and market research consultants were engaged to conduct the survey fieldwork. In the following sections, reference will be made to the latest completed TCS in 2022 (TCS2022) to illustrate the various operation details for planning and designing a home interview survey for transport planning purposes.

6.3 Objectives

6.3.1 Transport planning can be described as the determination of the appropriate provision and management of facilities to facilitate the safe and economic movement of person and goods so that the resulting performance of the transport system satisfies certain desirable criteria. The planning process consists of first drawing up a set of feasible facilities from engineering and other considerations, then determining what should be provided and how the whole system should be managed. The analytical framework includes the setting up of a lot of transport models relating the transport network characteristics and system performance under a set of travel demands which are themselves functions of the socio-economic characteristics of the community, and the behavior and choices of motorists and passengers in using the transport system.

6.3.2 To set up and test these models, a comprehensive database is required as input for the purposes. These data can be obtained by a series of special surveys and an assembly of facts routinely collected by various government departments. A home interview survey is usually required to collect information on the travel pattern and habits of the general public at large. When compared with other forms of data collection such as roadside interview survey, a home interview survey is the most effective and efficient means for collecting a complete set of information relating to travel pattern and habits of the public.

6.3.3 Since a large portion of travel demand is generated from the domestic household, it is important to know the fundamental characteristics of the households and evaluate their capacity for generating person travel demand. In addition, traffic forecasts are produced by transport models based on land use and demographic planning data related to the households in the planning data zones comprising the entire territory of Hong Kong. A domestic household comprises only related family members and live in visitors, if any, such as friends, and domestic helpers who live together under the same roof and share the household facilities. In particular, the objective of the home interview survey is designed to obtain three basic types of information from the survey:

(a) the composition and characteristics of the household as a unit

(b) the characteristics of each individual member of the household

(c) trips made by each individual member of the household on a reference day

6.3.4 The home interview survey is also designed to collect suitable data to assess the latest trend of travel characteristics and patterns of the mechanised trips made by the people of Hong Kong as a result of the changes in socio-economic situations, people’s lifestyles and habits, etc:

(a) the estimate of values of time of different groups categorised by trip purpose, transport mode and private vehicle availability

(b) the ownership and usage of private cars

(c) the people’s desire to walk and use pedestrian facilities

(d) the use of bicycles and electric vehicles as environmentally-friendly mode of transport

(e) views of elderly on transport services

(f) the effect of emerging lifestyles on travel behavior

6.4 Coverage

6.4.1 For TCS2022, a random sample of quarters or area segments will be selected from the Frame of Quarters (FoQ) maintained by the C&SD and all households within the sampled quarters or segments will be approached for provision of the information as set out in paragraph 6.3.3 and 6.3.4. The household interview surveys were conducted to collect data successfully from some 35,000 households (about 1.3% of all households in Hong Kong) through face-to-face interviews, telephone interviews and online questionnaires. The data collected were processed and grossed-up to represent the travel movements of all the people in Hong Kong on an average weekday in 2022. The details of adjustment of the collected data will be discussed in Section 6.7.2.

6.4.2 As mentioned in paragraph 6.4.1, only domestic households within the coverage areas will be included for selection for interview. For enquiries on personal characteristics, those people who are under a certain age and thus contribute very little to the overall person trip generation, will be excluded from the survey coverage. For TCS2022, the unit of enquiry was a person aged 2 or above. Inmates of institutions were excluded from the household interview survey and visitors living in hotels and hostel or same-day visitors were interviewed in a separate survey.

6.5 The Questionnaire

6.5.1 General Principles for Questionnaire Design

6.5.1.1 A list of topics regarding the required information should be compiled first. One approach is to consult stakeholders, such as academics interested in utilizing the collected survey data and to build up an action list based on their suggestions. However, the temptation to include excessive or irrelevant questions should be avoided. Lengthy and rambling questionnaires can be demoralising for both the enumerators and the respondents, which would adversely affect the effectiveness in data collection and quality of data collected. Therefore, the questionnaire should be kept as concise as possible to fulfil the survey objectives effectively.

6.5.1.2 Once all the essential questions needed to be included in the questionnaire have been finalised, a preliminary questionnaire may then be constructed for use in pre-testing/ pilot survey. This is a very important step as inadequate testing may result in expensive and time-wasting changes after the survey is in the field, or even worse, with inaccurate findings collected. It is therefore extremely important that each draft of the questionnaire should be fully tested, modified and retested among people who are representative of those to be included in the final sample.

6.5.1.3 The size of the pre-test/ pilot test bears little relationship to the size of the final sample, but there should be sufficient sample cases (50-100) in the pre-test/ pilot survey to determine whether or not the questionnaire is eliciting the kinds of data desired and whether or not it is manageable in the field. For practical reason, those who have already been selected in the final sample should not be included in the pre-test/ pilot test sample. Care must also be taken to ensure that the pre-test/ pilot survey sample does include a wide spectrum across the survey population.

6.5.1.4 Based on the experiences obtained from the pre-test/ pilot survey, the questionnaire to be used in the survey can be finalized.

6.5.2 Questionnaire Contents

6.5.2.1 Only those questions likely to be answered accurately by a respondent should be included in the questionnaire. For questions concerning facts that happened in the past, e.g. a respondent's trip details, a reference time not too far away from the date of interview should be used in order to minimise the chance of memory lapse from the respondent. For TCS2022, respondents were requested to provide trip information referred on the weekday immediately before the day of interview. The household interview survey of TCS2022 also included six attachment surveys on : car ownership and usage; travel propensity and walking; cycling and electric mobility devices; transport telematics and information dissemination; elderly travel behavior; and emerging lifestyles. In addition, stated preference surveys were also conducted for selected respondents to assess the impact of relate parameters affecting choices for users of various transport modes and choices of cross-harbour tunnels; as well as to derive the behavioural values of time.

6.5.2.2 Typical questions for a home interview survey for transport planning purpose may include the following:

(a) <u>Household Characteristics</u>
Usual Household Size
Household Composition
Monthly Household Income
Car Availability and Type of Parking

(b) <u>Personal Characteristics</u>
Gender

Age
Economic Activity Status
Work Place/Study Place

(c) Personal Trip Characteristics
Trip Origin and Destination
Trip Purpose
Time of Day
Mode of Travel
Journey Time and Cost
Parking Type and Cost for Vehicle Driver
Number of Passengers for Taxi Users

6.5.2.3 A list of the definition of terms commonly used in home interview Surveys for transport planning purposes is at Appendix 1

6.5.3 Criteria for Good Questions

6.5.3.1 Any given question should satisfy two broad objectives: it should obtain complete and accurate information while also maintaining the co-operation and good will of the respondent. There are therefore a number of specific criteria for good questions, including clarity, comprehensibility, unidimensionality, relevance, lack of suggestion, and applicability to the respondent.

6.5.3.2 For personal interviewing surveys, the wording of the questions should be standardized and read out by the enumerators to minimize any possible response error (one of the non-sampling errors). If required, the enumerators can help to explain the questions to the respondents during the interview, according to the guidelines. More details in this aspect will be discussed in section 6.8.2.

6.5.4 Open and Closed Questions

6.5.4.1 The difference between an open and a closed question is in the kind of response that the respondents are expected to provide. In an open question, the respondents are given freedom to decide the aspect, form, detail and length of their answers, and it is the enumerators' responsibility to record as much of the responses as possible. A closed question calls for a structured response and contains a number of mutually exclusive and exhaustive answer options from which the respondents are asked to choose.

6.5.4.2 Notwithstanding what have been mentioned, it should be noted that answers to both open and closed questions need to be properly coded before further processing of the data can take place. The only difference is that the answers for the closed questions will be pre-coded and printed in the questionnaire while the answers obtained from the open questions will be coded in the office after the completion of the interview.

6.5.4.3 For factual questions used in the questionnaire for the home interview survey for transport planning purposes, it would ideally be more desirable to use pre-coded questions for operational convenience. However, due to several technical challenges, the use of open questions may be unavoidable and the answers will be coded afterward.

6.5.5 Questionnaire Design to Maximise Trip Recording

6.5.5.1 Personal trip data can be recorded either by asking respondents to recall what happened at a time in the past (recall technique), or by announcing to respondents in advance that they will have to report travel about a future time (announce-in-advance technique). Both of these methods have variations as well as advantages and disadvantages.

6.5.5.2 The recall technique usually results in substantial errors in reporting of actual travel, especially when respondents are asked simply to recall travel for a specific period of time in the past. There are two

ways to improve data quality when using the simple recall technique. First, respondents can be assisted with prompts such as "Where did you go next?". This can help jog their memory and improve the accuracy of their responses. Another improvement is to ask respondents to think in terms of activities and not just trips. However, even with these improvements, there are still challenges in obtaining accurate trip data due to memory errors and respondents' unwillingness to provide detailed travel movements due to privacy consideration.

6.5.5.3 The announce-in-advance technique can provide more accurate trip data. Its methodology involves contacting the respondents in some way prior to the "reference day" of the survey. This means that respondents are more likely to record their travel as it happens or, at least be alert to the fact that they will have to report their travel, and thereby pay more attention to details of their travel on the reference day. This method allows respondents to actively remember their travel patterns and even take notes on their activities. To facilitate note-taking, enumerators often provide respondents with a brief diary. The advantage of providing a brief diary is that it will help respondents recall their trips made (provided the diaries are filled in regularly) but still will not resolve the issue on the unwillingness to provide detailed travel movements due to privacy consideration. On the other hand, this method may be perceived as burdensome by respondents, potentially reducing their participation in the survey.

6.5.6 The Organisation and Layout of the Questionnaire

6.5.6.1 The design of a questionnaire is not limited to finalising the questions to be included. It also involved various basic decisions, such as the order of questions and the size and colour of the questionnaire.

6.5.6.2 There are no hard and fast rules on how the questions should be organised and ordered. General guidelines for designing the question sequence include (1) using simple and interesting opening questions, (2) asking general question first, (3) placing uninteresting and difficult questions later in the sequence, and (4) arranging the questions in a logical order. In addition, the questionnaire should be organised in a way that is easy to handle for respondents, enumerators, checkers, coders, researchers, as well as data processing professionals to facilitate computer processing of the data collected.

6.5.6.3 From the point of view of the enumerator, the questionnaire should be designed for maximum ease of administration. It is crucial to plan the questionnaire in a way that makes it easy to read and record answers.

6.5.6.4 Enumerators should be provided with a separate list of instructions for each question so that they may guide the interview and provide interpretations of questions to respondents. Generally, these detailed instructions do not need to be included on every copy of the interview form since they should be contained in the Enumerators' Manual. However, brief reminders of instructions and specific prompts can be included at appropriate points of the form.

6.5.6.5 From the point of view of the checkers, coders and researchers, the questionnaire should be designed to facilitate editing, coding, identification, filing and storage. Each questionnaire should have enough identifying information and one or more questionnaire identification numbers. The identifying information is typically placed on the first page of the schedule and often includes items such as the survey date, the district, the name of the enumerator, details about visits and re-visits necessary to complete the questionnaire, the names of checkers/coders and other relevant information.

6.5.6.6 To facilitate computer processing of the data collected, comments should be sought from the data processing professionals on the suitability of the questionnaire for direct data preparation and storage.

6.6 Sample Design

6.6.1 Sampling Frame

6.6.1.1 There is not a frame of persons or households although, for household surveys, information on such units is our major interest. Instead, the FoQ maintained by C&SD can be used as a sampling frame for home interview surveys. Basically the FoQ consists of two parts:

(a) a listing of quarters in built-up areas and,

(b) a listing of area segments in non-built-up areas, each containing 8 to 15 temporary quarters.

6.6.1.2 The FoQ is updated continuously based on various sources of information, such as occupation permits, feedback from field visits, etc. Details of living quarters in the FoQ were used in determining the sample size for each stratum in TCS2022

6.6.1.3 Data items in the FoQ including, but not limited to, area code (e.g. District Council, Tertiary Planning Unit), type of living quarters were applied in the stratified sampling in TCS2022.

6.6.2 Sample Selection

6.6.2.1 To increase the precision of the estimates, the technique of stratification sampling will usually be used. The stratification variables to be used usually include district/area and type of living quarters. In TCS2022, three variables were adopted for stratification, including housing type, average household income and geographical districts:

i) Housing type – three housing types were defined which include “Public Rental”, “Subsidised Sale” and “Private & Others”.

ii) Average household income group of the territory – “Private & Others” housing type was further sub-divided into two household income categories including “High Income” and “Low Income”.

iii) Geographical districts – 32 sampling districts were defined.

6.6.2.2 This stratification resulted in a total of 105 strata.

6.6.2.3 Systematic samples will then be drawn within each of these strata. A number of replicate samples of smaller size will be sampled within each of the strata instead of selecting a single sample.

6.6.3 Sample Size

6.6.3.1 The sample size is determined taking into account various factors, including the precision of the estimates required. For TCS2022, a 1.3% sample size, amounting to 35,000 domestic households, was adopted.

6.6.3.2 The quality of survey results is subject to two main types of errors: sampling error and non-sampling error. Sampling error relates to the inference from a sample to the population and arises from the inherent variability of data among elements in the population. The sampling error is directly affected by sample size. Generally speaking, the larger the sample size, the smaller the sampling error. An effective sample design would also help to minimise the sampling error.

6.6.3.3 With an effective sampling strategy in place, further increasing the household sample size would enhance the precision but have marginal benefits in improving the accuracy and overall quality of the survey results. The review of international practice indicates that the TCS2022 sample size of 35,000 households is fairly high as compared to other metropolitan cities worldwide. For example, like Hong Kong, large-scale cross-sectional surveys were conducted once every five to ten years in cities such as New York State, Seoul and Singapore. The sample sizes adopted in their surveys were 16,200, 227,800 and 10,000 households respectively while the populations in these cities were 8,300,000[1], 9,600,000[2] and 5,900,000[3] respectively. With TCS2022 conducted once every ten years, a sample size of 35,000 households should be able to achieve a reasonable degree of accuracy for some of the major parameters and constitute a good balance between statistical and practical considerations. On the other hand, there is emerging trend that surveys are being conducted continuously every year like Sydney, Melbourne and London with respective sample sizes of 3,500, 4,500 and 8,000 households. A continuous survey has an advantage in providing data on trends in travel patterns and behaviour which reflect changing social and economic conditions.

6.6.3.4 Considering the increasing trend of trips being under-reported by the respondents, it would be far more important to direct the resources to reducing the non-sampling error arising from respondents' non-reporting or under-reporting of trips, than to increase the sample size. If the future TCS continues to be carried out as a single year cross-sectional survey, a sample size in the order of about 35,000 households should be generally adequate considering the precision level of estimates from a statistical point of view.

6.6.4 Supplementary Sample

6.6.4.1 Although the FoQ will be updated periodically, there will still be new living quarters coming into existence between the period when the frame was last updated and the actual selection of sample from the frame.

6.6.4.2 To cater for these new living quarters, a list of these units built since the last updating of the frame will have to be constructed, and out of which, a supplementary sample of the same percentage as the main sample will have to be selected for inclusion in the survey coverage so that these newly existed units can be properly represented in the surveys.

[1] Based on American Community Survey 2022
[2] Based on Seoul Metropolitan Government website, in 2024 Q1
[3] Based on Population Trends 2023 issued by Department of Statistics Singapore

6.7 Estimation

6.7.1 Population Estimates and Standard Error

6.7.1.1 The survey results are grossed up to the population totals by means of expansion factors assigned to household, person and trip records. Basically, the household and person variables are assigned expansion factors according to the different stratum they belong.

6.7.1.2 In addition to the characteristics mentioned, trip origin/destination, mid-journey time and senior mode of travel are also considered in the assignment of expansion factors for weekday trip records.

6.7.1.3 The estimates thus obtained are subject to both sampling and non-sampling errors, details of which will be discussed in section 6.10.

6.7.2 Calibration of Trip Data

6.7.2.1 In a home interview survey to collect information on travel pattern and behaviour of the population, it is known that some people will deliberately or inadvertently omit some of the trips they actually made at the time of survey. This under-reporting of trips, if not corrected, will lead to an emergence of a distorted trip pattern and behaviour, not representative of the actual conditions and the trip data as such may not then be useful for transport planning purpose.

6.7.2.2 The trip data obtained in a home interview survey thus have to be adjusted by checking against other independent sources of data, in particular the ground counts of person trips crossing selected screenlines derived from the Annual Traffic Census, passenger movement figures and average daily public transport boardings obtained from public transport operators. Another set of expansion factors for working out the total number of trips made by the respondents will need to be derived with corrections to the under-reporting of trips for different trip purposes, time periods and transport modes.

6.8 Field Operation

6.8.1 Field Operation Personnel

6.8.1.1 A summary of the procedures involved in the field operation is at Appendix II. Different personals are required to carry out the different activities.

(a) Enumerator:
- To conduct home interviews and complete the survey's questionnaires with information collected during the interview.
- To code the responses on the complete questionnaires afterwards.

(b) Fieldwork Supervisor:
- To assist Chief Fieldwork Supervisors in monitoring the quality of work of enumerators.
- To edit questionnaires completed by enumerators.

(c) Chief Fieldwork Supervisor:
- To assist Fieldwork Manager in monitoring fieldwork quality and progress.
- To coordinate and supervise the work of Fieldwork Supervisors and to train enumerators.

(d) Fieldwork Manager:
- To oversee the conduct of the survey and supervise all fieldwork staff.

(e) Field Editor:
- To check all questionnaires submitted by enumerators to ensure that they are duly completed and coded in clear writing.
- To perform some manual count of the completed questionnaires and to sub-sample some of them for quality check.

(f) Checker:
- To verify those living quarters reported by enumerators as vacant, demolished, under construction, used for non-domestic purposes and households reported as non-response or absent on the reference night.
- To conduct re-visits for a sample of enumerated households to check the accuracy of information collected by enumerators.
- To scrutinize and re-code all answers on the forms handed to him to ensure no information has been omitted or miscoded.

6.8.2 Training of Field Staff

6.8.2.1 To ensure safety, face-to-face interviews during home interview surveys shall be conducted by enumerators in pairs. Extensive training is also required for all the field staff, particularly for the enumerators. There are seven broad areas of training, including:

(a) Surveys objectives and design

(b) Subject matter of Surveys

(c) Questionnaire details

(d) Techniques

(e) Sampling frame

(f) Sampling

(g) Administrative details

6.8.2.2 For enumerators, however, the most important aspect of training is practice, which can be of two types: group practice in class and field practice under supervision of a more experienced enumerator.

6.8.3 Publicity

6.8.3.1 A press conference was delivered by TD senior management prior to the commencement of TCS2022 in providing a formal and widespread announcement of the details of the fieldwork.

6.8.3.2 To encourage better co-operation from households, it is important to promote a home interview survey through various means of publicity. The most effective form of publicity involves announcements in media such as newspapers, television, radio, internet, posters and leaflets. Another form of publicity is informing individual households that they will be included in a home interview survey. For the latter case, a letter will be sent to the households in advance. If possible, the name of the enumerator who will visit the household should be included in the letter. Moreover, a number of departments including the Hong Kong Police Force, the Housing Department, the various District Offices and the Government Hotline – 1823 will also be informed of the details of the surveys so that they can make the surveys known to their front line officers who are often approached by the general public for information, advice or assistance. These officers can play a valuable role in explaining the purpose and procedures of the surveys when being asked. For identification purpose, enumerators and other field staff should wear staff identity cards and uniforms when visiting households.

6.8.4 Data Collection

6.8.4.1 To prevent the loss of data collected in face-to-face interviews and uphold the security of the data, web-based Computer-Assisted Personal Interviewing (CAPI) technology shall be employed so that all responses to the questions in the questionnaire can be recorded and stored in the server in real-time, and no interview data will be retained in the computer tablets during and after the interview.

6.8.4.2 Some participants may have reservation over making contacts and appointment with the enumerators in person. Apart from home interview survey, online survey, online interview, telephone and mail-back questionnaire can be considered to improve the response rate of those participants. However, measures such as logic checks and guidelines in completing the questionnaire should be adopted to improve the data quality in terms of accuracy and missing information. When online surveys are adopted, it is important to allow sufficient time for the design and testing of the survey platform. The survey website, method of data entry and overall user experience should be carefully crafted to ensure the survey is easy for respondents to access, interpret and complete. Thorough testing is necessary to identify and resolve any technical issues or user experience problems, including compatibility with different digital devices, prior to launching the survey. Additionally, security measures must be implemented to protect the confidentiality of the data provided by the respondents.

6.8.4.3 To enhance the public cooperation, setting up of telephone hotline and dedicated website could be implemented. During the survey fieldwork period, the telephone enquiry hotline could be set up for making appointments for interviews, answering queries from respondents and confirming the identity of enumerators when necessary. A specific webpage for TCS2022 was also set up to disseminate relevant information and to allow self-completing the online questionnaire by the respondents.

6.8 5 Quality Control

6.8.5.1 The establishment of field editors and checkers will serve to ensure the quality of the enumeration work completed.

6.8.5.2 The quality of a survey also depends to a considerable degree on the calibre of the establishment and the effectiveness of its organization. Some of the specific concerns during the fieldwork are as follows:

(a) the time schedule

(b) the flow of materials

(c) the control of records

The most important is the need for the head office to keep complete and clear control over all records. This usually means large wall charts or registers showing the dates for surveys in each district, the number of interviews to be done, and the number of questionnaires, enumerators' and chief enumerators' reports expected to reach the head office. The head office should re-check every questionnaire and every report, and must on occasion send senior staff members to intervene personally in the field.

6.9 Processing of Data

6.9.1 In TCS2022, a series of quality control measures were employed at different stages of the data processing work as listed below:

(a) To ensure data quality, a set of built-in logic checks was set up in the web-based CAPI programme. Errors such as duplication or omission of records and out of range values or inconsistent of records were thus avoided and rectified respectively.

(b) A double data entry system was adopted for paper-based questionnaires to minimise the risk of incorrect data entry.

(c) All open-ended answers were coded by thoroughly trained full time coders and the work completed by each coder was 100% checked by senior coders.

(d) Validation checks of the address codes (e.g. trip origins and destinations) which were recorded by X-Y coordinates were carried out using GIS to ensure that they were reasonable.

(e) All input data had to go through a series of validity checks by computer.

(f) All inconsistencies and anomalies will be reflected for clarification and checking to see whether there are errors during data entry, coding or raw results from interviews and rectified as appropriate. Records with errors will be identified for further manual checking.

(g) All completed questionnaires will be stored in Government Cloud to ensure data security, which will be disposed after a period (say 6 months) from the completion of the survey contract. All personal details such as contact information will not appear in the survey databases used for subsequent analysis.

6.10 Sampling and Non-sampling Errors

6.10.1 Sampling Errors

6.10.1.1 Replicated sampling is usually used to facilitate the computation of sampling errors. More details with a worked example on replicated sampling can be found in Chapter 1, Section 1.3.4.8. In general, the estimates and sampling errors for a replicated sample are as follows:

$$\bar{z} = \frac{1}{c}\sum z_i$$

$$\text{var}(\bar{z}) = \frac{1}{c(c-1)}\sum (z_i - \bar{z})^2$$

where $\bar{z}$ = overall estimate
z_i = estimate from sub-sample i
c = number of independent sub-samples

6.10.2 Non-sampling Errors

6.10.2.1 Non-sampling errors are in general difficult, if not impossible, to quantify. More details on non-sampling errors can also be found in Chapter 1. In general, preventive measures should be taken before the conduction of a survey to minimise the extent of non-sampling errors instead of quantifying their extent and adjusting the survey estimates after the survey operation.

6.10.3 Non-response and Its Treatments

6.10.3.1 Non-response can be defined as the failure to collect all the required information from every sample element. Non-response has long been recognised as an important source of non-sampling errors in Surveys.

6.10.3.2 Two types of non-response can be differentiated: Unit non-response and item non-response. Unit non-response occurs when a unit included in the survey fails to provide usable information. Item non-response occurs when a sample unit provides usable response to some items but not to others. Differentiation between them is useful because each calls for different strategies for adjustment.

6.10.3.3 The most direct treatment of the non-response problem is to prevent non-response from occurring or at least to keep the level of non-response as low as possible. Some of the methods which can help to reduce the level of non-response are summarised below:

(a) Callbacks, follow-ups, and repeated telephone calls;

(b) Use of statistical technique like randomised response technique;

(c) Use of alternative (proxy) respondents;

(d) Use of financial incentives;

(e) Improving the quality of enumerators;

(f) Improving the questionnaire design;

(g) Improving publicity.

6.10.3.4 Despite much effort has been spent on improving the data collection method, there is, unfortunately, usually a hard-core of non-respondents who cannot be totally avoided. There are a variety of statistical techniques for adjusting missing data at the analysis stage. All of these adjustment procedures are based on certain assumptions which, if they hold, mean that the adjusted data are less biased than the unadjusted data. A summary of the commonly used adjustment procedures is given below but for more details a professional statistician should always be consulted.

(a) Implicit imputation

(b) Weighting adjustment

(c) Scientific imputation

6.11 Presentation of Results

6.11.1 Survey Report

6.11.1.1 The final survey report should include information on the following items:

(a) Objectives of the Survey
A statement of the objectives of the survey should also include an indication of the 'margin of error' which would be permissible for the purposes of the survey and the way in which the results are expected to be utilized. It is also necessary to indicate whether this is an ad-hoc survey, continuing survey, multi-purpose or specialised survey.

(b) Coverage of the Surveys
An exact description of the geographic regions and categories of the population covered by the survey should be given.

(c) Historical Background
A brief history of the previous surveys of similar nature should be given.

(d) Pilot Survey
The objectives, methodology, results obtained and how the decisions are influenced by the results of the pilot survey should be given if there is a pilot survey.

(e) Date and Duration
There are two periods of time which are important for any survey: (i) the period to which data refers, or reference period, and (ii) period of collection, i.e. the period taken for the fieldwork.

(f) Concepts and Definitions
A description of the concepts and definitions should be included either as a chapter of the report or in an appendix.

(g) Methodology
A brief description of the survey methodology should be included in the survey report even if a technical report with a detailed description of the methodology is being issued separately.

(h) Collection of Information
The nature of information collected should be reported in considerable detail. The questionnaire used in the survey should be included in the report as an appendix.

(i) Processing and Tabulation
The editing, coding, classification and tabulation methods should be described.

(j) Summary of Results
A summary of important results should be presented. A general indication should be given of the methods followed in the derivation of the numerical results. Any special methods for handling non-response, under-reporting and other survey operation issues should be described.

(k) Accuracy
A general indication of the accuracy obtained should be given and a distinction should be made between sampling and non-sampling errors.

(l) Responsibility
The name of the organisations sponsoring or conducting the survey should be stated.

(m) References
References should be given to any available reports or papers relating to the survey.

6.11.2 Summary of Results

6.11.2.1 For the purposes of transport studies, the Territory has been divided into internal traffic zones. These traffic zones are the basic units for travel demand analysis, where trips are generated from or attracted to. For the purpose of analysis and presentation of results, the traffic zones are also grouped into traffic sections which are in turn further aggregated into traffic areas. The traffic zoning system for transport studies has undergone a number of changes over the past years. In the 1981 Special Surveys on Transport Characteristics, the Territory was divided into 555 traffic zones. In the TCSs carried out in 1992, 2002 and 2011, the Territory was divided into 264, 405 and 454 traffic zones respectively. In the latest TCS2022, the same 454 traffic zones were maintained.

6.11.2.2 The following parameters were analysed for the TCS2022 results and the trends of the changes in the parameter values collected in the previous TCSs were also examined:

(a) Household and Personal Characteristics
Distribution of Population and Domestic Households
Monthly Household Income
Household Size and Composition
Economic Activity Status
Work Place
Study Place

(b) Car Availability
Geographical Distribution of Car Available Households, with breakdown into single vehicle owning or multiple vehicle owning
Monthly Household Income
Overnight Parking

(c) Weekday Trip Characteristics
Trip Generation and Attraction by Trip Purpose
Mode of Travel
Trip Origin and Destination
Time of Day
Trip legs and Modal Transfers
Car Trips
Trip Generation Rates
Journey Time and Cost

(d) Supplementary Information on Special Topics
Travel Propensity and Walking
Transport Information System
Elderly Travel Behaviour
Emerging Lifestyles
Cycling and Electric Mobility Devices

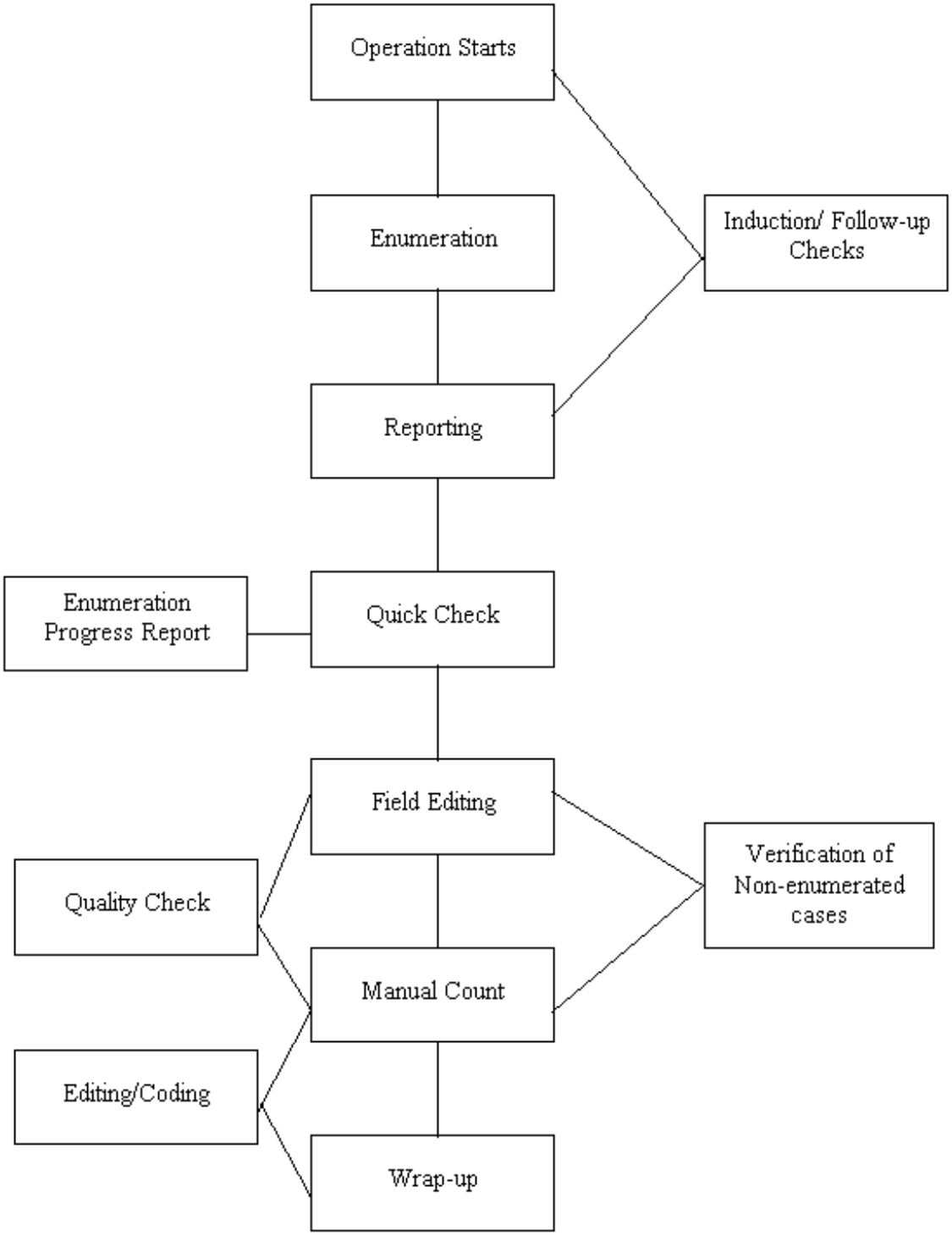
Appendix I

	Definition of Commonly Used Terms
1. Traffic zone	- A basically homogeneous area of land to and from the centroid of which trips are assumed to be attracted and generated.
2. Traffic area	- Hong Kong Island, Kowloon, New Kowloon, Tsuen Wan and Other N.T.
3. Traffic sector	- A geographical district made up of traffic zones.
4. Car availability	- It refers to the number of (white registration numbers plates) private cars, or motor cycles available to I serve household members for personal uses. The car availability of a household is classified into 4 categories: (i) Non-car available households - those households which do not have a car or motor cycle available for their personal use. (ii) One-car available households - those households with one car and/or any number of motor cycles available. (iii) Two plus car available households - those households with 2 or more cars irrespective of the number of motor cycles available.
5. Worker	- A person of age 15 and older, who was engaged in productive work for a significant period prior to the Surveys. These people interviewed were asked to classify themselves as to whether they were worker or not.
6. Student	- A person 4 years of age and older who is attending full-time school.
7. Trip	- A trip is the one-way movement from one place to another for a single general purpose. Each trip is comprised of one or more trip legs.
8. Trip leg	- A trip leg is that part of a trip without a change of vehicle/vessel.
9. Mode of Travel	- A mode is the form of mechanised movement used by a person to make a trip.
10. Senior mode of travel of a trip	- For a trip involving more than one mode, it refers to the most senior mode of travel according to the agreed ranking of modes.
11. Origin purpose of a trip leg	- The reason why a person is at that address before the trip starts.
12. Destination purpose of a trip leg	- The reason why a person goes to that address.

	Definition of Commonly Used Terms
13. Purpose of a trip leg	- It refers to the destination purpose. of the whole trip unless the purpose. is "Home" in which case it refers to the origin purpose.
14. Purpose of a trip	- It refers to the destination purpose of the trip unless the purpose is "Home", in which case it refers to the origin purpose. However, it is normally classified as (i) Home Based Work, (ii) Home Based Study, (iii) Other Home Based, (iv) Non-Home Based, and (v) Employer's Business.
15. Home Based Work trip	- A trip with one trip end purpose as "Home" and the other trip end purpose as "Work".
16. Home Based Study trip	- A trip with one trip end purpose as "Home" and the other trip end purpose as "Study".
17. Other Home Based trip	- A trip with one trip end purpose as "Home" and the other trip end purpose not "Work" and not "Study"
18. Non-Home Based trip	- A trip with neither the origin nor the destination having a "Home" purpose.
19. Employer's Business trip	- A trip between two places of work.
20. Private trip	- A trip using private car or motorcycle as a passenger or driver, or a taxi as a passenger.
21. Modal transfer	- The number of times of changing vehicles/ vessels of the same or different modes within a trip.
22. Parking cost	- The total parking cost of car trips.
23. Average cost per trip leg	- For public transport or taxi, it refers to the average fare per person per trip leg. For Car trip, it refers to the average park1ng cost per trip leg.
24. Average journey time per trip	- Journey time refers to the duration between the starting time and the arrival time, i.e. it covers the walking time, the waiting time and the in-vehicle time.

Appendix II

General Field Operation Procedures: A Summary



TPDM Volume 8 Chapter 7 – Other Surveys

7.1 References

1 Traffic Planning and Engineering - Second Edition by F.D. Hobbs

2 MICHAEL A.P. TAYLOR, “New Technology in Traffic Data Collection”, Department of Civil Engineering, Monash University, 1986.

7.2 Introduction

7.2.1 General

7.2.1.1 The patterns of traffic movements cover a wide range of characteristics. The conduct of traffic surveys to collect data for ascertaining such characteristics is one of the important basic steps for the study and design of measures to cope with different types of traffic problems.

7.2.1.2 There are a great variety of traffic surveys, each suited to a specific study objective. Of these different types of surveys, some are more frequently conducted and often on annual re-current basis with a view to updating information for monitoring the changes in traffic movement characteristics while some are conducted on an ad hoc basis for the investigation or study of specific traffic problems.

7.2.1.3 Surveys of re-current nature are fully documented in the preceding chapters of this volume. This chapter deals with the discussions of a certain types of ad-hoc surveys which are more useful and commonly conducted. These surveys are classified into two major types namely "Origin - Destination Surveys" and "Queuing and Delay Surveys" each involving different survey techniques.

7.3 Origin - Destination Surveys

7.3.1 Uses of Origin - Destination Surveys

A variety of survey techniques are used to estimate the origins and destinations of traffic movements, for data on trip distribution patterns are essential in situations where diversion of traffic may result from a new traffic management scheme. Such cases include the provision of a new road facility (e.g. a bridge or bypass road), the development of a large traffic generator (e.g. a new regional shopping centre), or a proposed restraint on trip movements (e.g. a street closure in a residential area, or pedestrianisation of a shopping street). Origin - destination (OD) surveys may be employed to provide a quantitative assessment of the amount of traffic likely to be affected by the proposal, and the consequent impacts on various elements in the road system.

7.3.2 Types of Origin - Destination Surveys

The commonly used surveys for gathering OD data include the following

(a) Elevated Observer Survey,

(b) Roadside Interview Survey,

(c) Postcard Survey,

(d) Tag Survey, and

(e) Number Plate Matching Survey

The methodology of each of the above surveys will be discussed in the following sections.

7.3.3 Elevated Observer Survey

In this method an observer is positioned with a view of a series of junctions or streets, and traces the routes of individual vehicles which enter the field of view. The turning movement survey is the most common and simplest survey of this type. The technique is often most cost-effective than other methods of surveys in local area traffic management studies, especially when traffic patterns can be determined from observations at a few critical sites in close proximity. Analysis is done in the field, and there are few significant recording errors. Binoculars will extend the field of view. Explicit instructions must be given to the observer for selecting which vehicle to track next. There may, of course, be significant problems in finding suitable vantage points for observations of vehicles movements over a sequence of road links. This survey technique can also be successfully used to study pedestrian movements, say in a shopping street or plaza.

7.3.4 Roadside Interview Survey

This survey type presents the best opportunity to gather comprehensive data on traffic movements. Vehicles are directed into a roadside station, and drivers are asked to respond to a preset questionnaire about the details of their trip. Hence the prerequisite conditions to the use of this method are the availability of suitable roadside bays and the full assistance of police officers on site to stop sampled vehicles for interview. The technique allows the collection of information not available from simple observation (e.g. the exact origin and ultimate destination of a trip can be found, together with information on trip purpose and frequency). The interview will be fairly short compared to those used in say, household interviews in transport planning. Nevertheless the principles of good questionnaire design should be applied. The interview should be short, simple, unambiguous to both the interviewer and the interviewee, and only seek information relevant to the purpose of the study. In this regard, it is suggested that when other Divisions are planning such a survey, they should consult TTSD for the

design of questionnaire. A typical example of this type of survey is the Cross Boundary Traffic Survey conducted annually by TTSD in which roadside interviews form a major part of the fieldwork.

7.3.5 Postcard Survey

This technique is a scaled-down version of the roadside interview, in which drivers are requested to take and complete a self-administered questionnaire, and then post it back to the survey organisation. Good practice requires that the postage be reply-paid, to increase the response rate. Postcard Surveys return similar data to roadside interviews, with perhaps less detail possible. They are of some advantage when additional trip information is required to that available by direct observation. The care necessary in all questionnaire survey design is required, as in the roadside interview.

7.3.6 Tag Survey

With this method drivers must be stopped twice if maximum amount of information is to be obtained and for this reason it is considered not practicable to use it under heavy traffic conditions. However this method can be modified for obtaining only the origins and destinations of vehicles at signal-controlled junctions. The procedure is to stick a tag of distinctive colour on the windscreen of sampled vehicles waiting to clear the junction at the incoming point, a different colour being used for each point. At the outgoing end, the enumerator records the number of vehicles with each different colour tag, thus the O. and D. distribution pattern of vehicle through the junction can be obtained.

7.3.7 Number Plate Matching Survey

7.3.7.1 Introduction

Of all the OD survey techniques, this is the most popular one. Hence, more detailed discussions of the methodology will be given in the following sections. Basically, the method involves stationing observers at selected points in and around an area to record the number plates of vehicles, and the time each vehicle passes the observer. The route taken by a vehicle can then be found by matching the observations. This technique is best suited to traffic patterns characterised by a large number of origins and destinations linked by a complex road network. This is the situation found in an urban area. One disadvantage of this technique, shared with others such as roadside interviews and postcard surveys, is the large amount of effort required in data coding and analysis. Another disadvantage of this technique is the sighting problem that might occur at night. Recent developments in the use of portable computers or personal digital assistants (PDA)s in traffic data collection and analysis have helped to mitigate the first problem, and there are now several commercially available programs for analysing OD data.

7.3.7.2 Main Points of Survey Methodology

(i) Defining a Cordon

The cordon is the boundary around the study area, for which information on trip movements is required. It may consist of physical boundaries (e.g. rivers, hills, parkland), major transport facilities (e.g. railways, freeways or other links with limited access or crossing opportunities), jurisdiction boundaries (e.g. District Council boundaries), or arbitrary boundaries. The study purposes should point to the extent of the survey area, and the objectives and constraints should be used to set the exact details of the cordon. survey stations are then located on the cordon and possibly inside the areas, to permit observation of movements into, inside and out of the area. Stations need to be located with care, both to minimise the number of stations while maintaining the required level of detail, and removing possible ambiguities on the data. Internal stations (i.e. observation points inside the study area) are often required in addition to the cordon line stations. The internal stations may be used to trace the routes taken by vehicles

(ii) Setting the Survey Time

The time of day for the survey should be chosen to cover the period when "divertable"

traffic will be observed (e.g. peak period flows in urban areas or busy shopping times at a shopping centre). The duration of the survey is also of concern. Naturally the observations must cover the period when "divertable" traffic will be observed, but there is a further requirement. This relates to the possibilities for mismatching of vehicle observations due to "start up" and "close down" non-matching errors, as discussed under the section on survey errors.

(iii) Setting the Sample Rate

Sampling of number plates is usually performed on the basis of the last digit of the number plate. Sampling on the basis of the last digit ending in say, "4" will result in a sampling rate of one in ten, whilst sampling all vehicles with plates ending in "1" and "2" would give a sampling rate of one in five. Note that these are not sample sizes or proportions, and have no statistical meaning unless converted to a sample size on the basis of the total number of vehicles sampled on a particular road, or between a particular origin - destination pair.

Recommended practice is to select a digit which is less likely to be confused with others (e.g. “6”, “8” and “9” are not good choices). The digits “1” and “4” are commonly used.

Sometimes due to heavy traffic flows or vehicles moving at high speeds, enumerators may find it difficult to capture all vehicles with plates ending in a specific digit. Under such circumstances, it is a common practice to confine sampling to vehicles of certain colours. Before choosing the vehicle colours in order to achieve the target sampling rate, it is necessary to obtain information on the proportions of vehicles by colour by carrying out simple counts.

(iv) Field Data Collection

The following information is usually recorded for each observation :-

(a) number plate (to specify number of characters);

(b) location

(c) direction of travel;

(d) time of observation; and

(e) (optionally) the type of vehicle.

Prior to the commencement of recording, enumerators should synchronize their watches. Recording may be done with paper and pencil, or a cassette tape recorder, or by PDAs/portablecomputers. The PDA/portable computers have a number of advantages (e.g. inbuilt clocks to log arrival times automatically, and immediate computer - readable data), but the other techniques have certain favourable features. When all else fails, the survey form provides a fairly intelligible and reconstructible storage medium. Cassette recordings are useful for heavy traffic flows, but are tedious to transcribe after the survey and may have their own special types of errors. Tape recording is one way of reducing staff requirements at the survey, e.g. one person with a recorder may suffice when two people would be needed with paper and pencil (one calls out the plate while the other copies it down). But there is the problem of possible tape jams. A recommendation is to only use short duration tapes say, 60 minutes (30 minutes per side). Longer duration tapes tend to be unreliable in repeated use in the field, despite the apparent advantage of fewer change-overs. A sample instruction sheet and record form are shown in APPENDIX A for reference.

(v) Survey Errors

(a) Start-up and Shut-down Errors

As every trip in the study area will involve a finite travel time, the first vehicles

leaving the cordon at the start of the survey will be interpreted as local trips even if they are in fact through trips. As they entered the study area before the start of the survey, there are no records of their entries. A similar problem occurs at the end of the survey. Without an adjustment for these errors, the results will be biased against through traffic, especially if the survey area is large or the survey duration is short. Two adjustment techniques can be applied :-

i discard all observations leaving the cordon an arbitrary time after the start of the survey (say five minutes) and entering the cordon an arbitrary time before the end of the survey; and

ii use manual matching of number plates at the start of the survey to determine the time at which the first "wave" of vehicles entering the cordon at the start passed each station. Observations prior to this wave can be discarded. A similar technique may be applied at the end of the survey.

(b) Recording Errors

The following recording errors are commonly seen, and the order is an indication of the relative frequencies of occurrence :-

i the number is missed completely;

ii one or more characters are mis-recorded, or two characters are transposed (usually the middle two characters in a group of four);

iii the direction of movement is recorded incorrectly, by a person who is recording more than one direction; and

iv the type of vehicle is mis-recorded.

The consequence of any of these errors will normally exclude the possibility of a successful match with another observation, with the possible exception of (iv) above. The main difficulty with recording errors in number plate surveys is that errors will propagate. One mis-recorded number plate will lead to two apparent unmatched vehicles in the subsequent analysis. Attention to methods, which can reduce recording errors, is therefore essential in good survey practice. The "calibration" of each observer, to find their likely accuracy rates is a first step when selecting suitable survey personnel.

(vi) Data Analysis

Analysis of OD data can be carried out by the application of computer programs, and there are several microcomputer-based programs available. However there are some points to watch. Each program will have its own internal logic, and it is possible that two different programs will generate quite different results. It is rare for the programs to account for observer errors, and usually they search for matchings of number plates, with no editing facilities once the data are entered into the program.

(vii) Result Presentation

The main result from an OD survey is usually a matrix showing the trips from each origin to every destination defined in the study. This matrix is known as the origin - destination or trip - interchange matrix. A convenient representation of the OD matrix is the desire line diagram. This shows the trip movements between origin - destination pairs as coloured or shaded blocks superimposed on a map of the study area.

A useful extension to the conventional two-dimensional OD table is the three-dimensional table in which the third axis contains either :-

(a) the internal stations, thus indicating the routes taken through the area; or

(b) time, so that the changes in trip movements over the survey period can be assessed.

7.4 Queuing and Delay Surveys

7.4.1 Introduction

Two often-used measures of the effectiveness of a traffic system are queuing within the system and the delay incurred by drivers passing through the system. In considering these measures the first point to note is that they are not the only measures of performance. Other measures, such as fuel consumption, energy loss, number of stops, connectivity etc. can also be used to aid in the assessment of system performance.
The following sections describe the general survey methodologies for assessing queuing and traffic delay in a traffic system.

7.4.2 Queuing Surveys

7.4.2.1 Before discussing the measurement of queue lengths it is necessary to define what is a traffic queue. A vehicle is in a queue when it is controlled in its actions by the vehicle in front of it or has been stopped by a component of the traffic system. Queues can therefore occur in traffic moving along the open road as well as at constrictions in the traffic system. This section will concentrate on queues forming in the proximity of an intersection or a constriction in the road.

7.4.2.2 To illustrate the various measurements associated with a queue of stopped vehicles consider a signalised intersection with vehicles arriving and departing uniformly. Vehicles arriving during the red phase are halted and are not able to leave during the red phase. The vehicles stopped at the intersection can depart when the green phase starts. The vehicles stopping at the intersection when the lights turn green represent the maximum stationary queue. After the green time start vehicles leave the intersection faster than they arrive. Hence the queue decreases in total size but since it takes time for the front vehicles to move the latter vehicles remain stationary for some time after the traffic lights turn green. The point in time when the last stationary vehicle in the queue moves determines the maximum back of queue. This is of interest since it represents the physical end of the queue as perceived by the driver. Another queue that is of interest is termed the over flow queue. This is the number of vehicles that are still present at the end of the green period.

7.4.2.3 The above discussion has related to traffic signals. In this case the event that determined the critical time of queue measurement was the change in phase. Queues forming at uncontrolled intersections or at other constrictions in the traffic system have the same characteristics as those present at a signalised intersection. The main difference lies in the critical time of queue measurement. In these cases it is likely to be the departure of a vehicle from the head of the queue that determines the critical queue lengths.

7.4.2.4 Measurement of the queue lengths involves an observer recording the number of stationary vehicles and vehicles slowing down to join the queue at particular point in time. This can be done by physically counting the vehicle or by placing marks along the road length to indicate the number of vehicles that would be in a queue of a given physical length. Video cameras or time lapse photography can be used to record the queue lengths for later analysis.

7.4.3 Delay Surveys

7.4.3.1 Introduction

There are many types of traffic delay, all of which lower the running speed below a reasonable value and represent time that is non-productive. Stopped delay is the delay experienced by vehicles that have actually stopped. This can also be referred to as queuing delay. Congestion delay can include both the delay due to queuing and that resultant from vehicles having to slow down because of interactions with other vehicles.

7.4.3.2 Survey Methods

The three basic methods for estimating delay are described in the following sections :-

(i) Point sample method

The point sample method is based on the periodic sampling of some factor. This may be the number of stopped vehicles at the start of the green phase on the approach section of a signalised intersection or the number of vehicles stopped when a vehicle exits the queue at a congested section of road. The procedure is most easily adapted to systematic sampling (either fixed intervals or on a per cycle basis), although it is possible to use other types of sampling (e.g. random). The travel time (T) on the approach to a signalised intersection, over a specific period can be calculated using the formulae :-

where $T = N.t/V$

N = total density in vehicles (i.e. number of vehicles in delay section at an instant),

t = interval in seconds between successive density counts,

V = volume of vehicles leaving section.

A hand counter, watch and one or more observers are required to collect the data. Although the accuracy of the method deteriorates rapidly at low volumes it increases with smaller time intervals between successive density counts. The method suffers from the fact that it requires a nearby vantage point for the observer.

(ii) Path trace method

In the path trace method, data on individual vehicles traversing the delay section are recorded. The method is based on a sample of vehicles entering the study area. Sampling of vehicles may be fixed, systematic, random or a combination of these. Typical data recorded includes times of stops, starts, lane changes and so on. This data may be categorised as either intersection - related or non-intersection related.

Data may be recorded by utilisation of a test vehicle, a stationary observer, time lapse photography, or by videotaping vehicle movements on the study approach. The test vehicle has advantages when long section of road are to be considered, such as the case of measuring the delays of vehicles joining the long queues at Cross Harbour Tunnel.

(iii) Input-output method

The input-output method measures the flow of vehicles into and out of the delay section. Several approaches have been developed the most common of which is the recording of car registration numbers into and out of the system and the matching of these at a later date. This approach has considerable advantages in determining delay since it can isolate vehicles making particular manoeuvres. However, this method does not reveal the cause, location or duration of stopped delays and so gives only journey speeds. Besides, it is also time consuming and expensive.

7.4.3.3 Desired Speed Determination

The delay on a particular road section is the difference between the travel time measured during the study period and the desired travel time or base travel time. Therefore, critical assumption in all studies

of delay is that relating to desired speed. In defining base speed the following methods might be considered :-

(i) Posted speed limit

The posted speed limit would produce the highest desired speed and would thus result in a large delay measure. Its main application would be when testing the ability of people to achieve the speed limit. The speed limit being considered as the speed which drivers should be able to adopt.

(ii) Spot and point speed

This method consists of the observer taking speed measurements at points in the network where there is no immediate interference to traffic flow (i.e. at points as far removed from intersections and pedestrian crossings etc.). The vehicles used to determine the spot speed should be randomly selected. This approach is likely to produce a free flow speed below that produced using the posted speed limit approach.

(iii) Free flow speed

The free flow speed is the average speed on the study route for unimpeded vehicles. It is obtained by measuring the speeds of a random set of vehicles travelling through the study area during periods of low demand when there is little interference between vehicles. It is likely to produce a different speed to the above two methods. It will be higher or lower than the spot speed depending on the comparison of the total route conditions and the conditions where the spot speeds were taken.

APPENDIX A-1 Sample Instruction Sheet

Number Plate Matching Surveys

General

(1) The Surveys will take place on _____ from hrs. to _____ hrs.

(2) Please bring
- Surveys forms
- a watch
- a clipboard
- pens

(3) Assemble at the meeting point at _____ (i.e. 15 minutes before the start of Surveys). The supervisor will be there to brief you and synchronize your watch. Start your Surveys at exactly .

(4) At _____, finish your Surveys and return to the meeting point to hand over the data.

Specific

(1) Register only number plates finishing in an odd digit, i.e. 1, 3, 5, 7 or 9

(2) Record the whole licence plate
e.g. AE 1573
CD 821

(3) Record all vehicles, except
- motorcycles
- CTB, NWFB and KMB buses
- GMB buses
- RMB buses

(4) If you miss a vehicle, score a line through the box.

(5) Note the time to the nearest minutes at the side of each row. Record number plates in all the boxes of one row before moving on to the next.

(6) Start a new row at least every three minutes.

APPENDIX A-2 Sample Surveys Form
Number Plate Matching Surveys

Location : ______________________ Bound : ______________________

Job No. : ______________________ Weather : ______________________

Observed by : ______________________ Date : ______________________

Time Period : ____

Remarks : ____

Time	Number	Type				Time	Number	Type				Time	Number	Type			
		P	T	G	O			P	T	G	O			P	T	G	O
		P	T	G	O			P	T	G	O			P	T	G	O
		P	T	G	O			P	T	G	O			P	T	G	O
		P	T	G	O			P	T	G	O			P	T	G	O
		P	T	G	O			P	T	G	O			P	T	G	O
		P	T	G	O			P	T	G	O			P	T	G	O
		P	T	G	O			P	T	G	O			P	T	G	O
		P	T	G	O			P	T	G	O			P	T	G	O
		P	T	G	O			P	T	G	O			P	T	G	O
		P	T	G	O			P	T	G	O			P	T	G	O
		P	T	G	O			P	T	G	O			P	T	G	O
		P	T	G	O			P	T	G	O			P	T	G	O
		P	T	G	O			P	T	G	O			P	T	G	O
		P	T	G	O			P	T	G	O			P	T	G	O
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		P	T	G	O			P	T	G	O			P	T	G	O
		P	T	G	O			P	T	G	O			P	T	G	O
		P	T	G	O			P	T	G	O			P	T	G	O
		P	T	G	O			P	T	G	O			P	T	G	O
		P	T	G	O			P	T	G	O			P	T	G	O
		P	T	G	O			P	T	G	O			P	T	G	O
		P	T	G	O			P	T	G	O			P	T	G	O
		P	T	G	O			P	T	G	O			P	T	G	O
		P	T	G	O			P	T	G	O			P	T	G	O

P = Private Car T = Taxi G = Goods Vehicle O = Others (Coach, Passanger Van, PLB etc.)