THE CANBERRA SHORT TERM TRANSPORTATION STUDY

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ABSTRACT: *In 1974, the National Capital Development Commission announced a formal shift in emphasis in transport planning, designed primarily to support long-term development of more effective local and inter-town public transport, to be fostered in part by measures to discourage use of private cars for commuting to work. Consultants were appointed to develop a transport plan for the period from the mid-1970's to the early 1980's for the management of the transport system in a manner designed to foster a smooth transition to a higher level of transit dependence when major new transport facilities are available in the 1980's. The questions for planning and evaluation posed by the new policy approach called for the development of policy sensitive models and the study relied heavily on the use of disaggregate travel demand models to handle questions for which traditional four-step modelling techniques are unsuitable. A parallel program of public participation was undertaken by the National Capital Development Commission to test public acceptability of proposed measures.*

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INTRODUCTION

In 1974, the National Capital Development Commission announced a new general approach to transport planning in Canberra based on:

a) A limitation of road space to that required to meet *off-peak* needs.

b) Associated control of traffic and parking to minimise congestion and environmental problems, especially at peak periods.

c) The improvement of public transport to provide both the necessary extra capacity for commuters and a higher level of service to meet social needs.

In 1975, the Commission invited competitive submissions from consultants for a project designed to assist in development of measures for the period 1975-82, which was seen as a transitional period in the development of a more transit-dependent system. Public acceptability questions were to be dealt with concurrently by the Commission. The Short-Term Transportation Plan (STTP) period was such that no significant construction could be contemplated that was not already committed, indicating an emphasis on traffic management and control of parking as the principal policy instruments. The study was also required to provide the National Capital Development Commission with an enhanced capability for long-term transport planning and analysis, and was required to show that measures indicated for the short-term planning period were consistent with future land use and transport development envisaged for Canberra in the longer term.

P.G. Pak-Poy & Associates Pty. Ltd. and John Paterson Urban Systems Pty. Ltd. were appointed as joint consultants to undertake the project, which commenced in August 1975. The major tasks in the study were to be as follows:

(a) Collection of the usual range of data requirements for transport planning, including a household interview survey, commercial vehicle survey and roadside interviews at internal screenlines and at the external cordon.

(b) Development of a set of models along more or less conventional lines for long-term projections and for detailed analysis of road and public transport networks.

(c) Development of appropriate models for policy analysis to permit simulation and evaluation of a range of management alternatives.

A complete set of transport planning surveys has never been conducted in Canberra, and up to the present the National Capital Development Commission has relied on models based on parameters derived from other cities and adjusted to conform with either observed volumes or limited OD surveys conducted within Canberra. While the survey element of the program will provide a valuable new resource, the most novel element of the project involves task (c) above, a development of policy sensitive models for analysing short-term management issues. Techniques known variously as disaggregate, or behavioural demand modelling, or as probabilistic choice modelling, were selected for this task. Disaggregate demand modelling experience in Australia is at present largely confined

to work undertaken by or for the Commonwealth Bureau of Roads. To compensate for the lack of local experience in the field, Cambridge Systematics Inc. of Cambridge Massachusetts, a firm closely associated with the Engineering Systems Laboratory of MIT, was engaged as subconsultant for the supply of appropriate computer packages and advice during the conduct of the study. The technical support of CSI has proved of value in shortcutting the learning process which would otherwise have been difficult to accommodate within the nine months study period.

The Household Interview Survey had a number of questions included which depart from general practice and which were dictated by the policy issues to be faced and by the requirements of disaggregate demand modelling. This is discussed further in the following sections.

TRAVEL MODELS

Apart from meeting the requirements of the project, model development was required to leave the Commission with an inhouse capability to handle its own future transport needs. While a number of well established suites were available and in common use in Australia, for the production, distribution and assignment elements of the traditional sequential modelling process, it was decided after a review of available software that the Urban Mass Transit Administration (UMTA) Suite, represents the most comprehensive available set of integrated programs and, more importantly, is backed by a commitment to ongoing development and refinement by UMTA which means that a commitment to use of the suite by a planning agency is less likely to result in future obsolescence of investment in planning analytics than would be the case if investment were

made in one of the better known suites for which no similar long-term servicing commitment exists. In view of the present capabilities and future promise of the UMTA package, it is judged to be likely that this will rapidly become the transport planning suite in general use in most parts of the world.

The model used in the 4-step section of the work is discussed in detail in the Commonwealth Bureau of Roads paper, *Development of a Multimodal Model for Evaluating Urban Transport Strategies*, C.A. Nash, November 1974. The most general specification of the model is given by

$$I_{ijkn} = \frac{P_{ik} A_{jk} \exp \beta_k C_{ijn}}{\sum_n \sum_j A_j \exp \beta_{kn} C_{ijn}}$$

where i,j are the zones of production and attraction
k refers to person type
n refers to mode
P refers to trip productions
A refers to trip attractions.

This formulation compresses distribution and mode choice into one *simultaneously estimated operation*. The modal split model may be deduced from this formulation:

$$I_{ijk_1} / I_{ijk_2} = \exp \beta_k (C_{ij_1} - C_{ij_2})$$

where $_1$ and $_2$ refer to rival modes.

Trip productions and attractions will be estimated in two distinct ways:

a) Zonal regression
b) Category analysis.

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The comparison of results from the two methodologies should prove to be of considerable interest. Assignments will be carried out using the two assignment functions of the UMTA suite, UROAD and ULOAD. UROAD is a stochastic, capacity-restrained mechanism for highway traffic assignment and ULOAD is the UMTA transit assignment program.

The UMTA suite contains a multinomial logit estimation module which could have served for estimation of disaggregate choice models for use in the policy analysis phase of the study. However, an evaluation of the UMTA Logit Estimation package, and the Maximum Likelihood Estimator (MLE) package developed by Cambridge Systematics Inc. for multinomial logit estimation, led to a conclusion that the CSI package had a number of practical advantages. While estimation of disaggregate demand for disaggregate choice models could have been achieved within the context of the UMTA suite, CSI have produced a valuable projection package for the application of multi-nomial logit models to policy analysis.

Those familiar with the literature on disaggregate demand modelling will be aware that the application of the individual choice model to policy analysis requires aggregation, since policies are analysed in terms of the response of the total population (perhaps stratified in respect to key variables) rather than at the individual level. A number of approaches to aggregation are available and while each has its advocates, there is now appearing a convergence of opinion on the appropriateness of the various means available. The Cambridge Systematics method may be described as a sample simulation approach and is of particular value for looking at distributional effects and for looking at the different responses of sub groups of the population which add up to a total population response to particular policy or environmental changes.

The CSI method approaches the aggregation problem in the following manner. Sample data is initially used to estimate a multinomial logit model for exploring, let's say, mode choice behaviour. The observed choices made by members of the original sample form a basis for estimation of parameters of the choice model. Individual observed choices are presumed to follow from the particular circumstances of each individual in the sample, and the response patterns estimated by the logit estimation are valid for the range of observed individual circumstances in the sample set. Application of the model is achieved by returning to the individual sample, and for each individual member of the sample, *resetting* the variables which are under analysis. For example, if a change in network speed is envisaged, the effect of this on the journey time of each individual in the sample is calculated and the new value used to replace the original travel time on the individual observation. Then for each individual in the sample the new mode choice probabilities are calculated, thereby simulating the response of each individual to the new service conditions. By summing the new choices over the sample set, the change in mode split can be directly calculated, but in addition to this, the sample set can be stratified in terms of any chosen criteria - age, sex, auto ownership, income, etc. and *distributional* issues analysed by looking at the different pattern of responses within sub groups of the total sample so stratified. Consequently, the CSI aggregation technique provides a powerful tool for analysing distributional issues as well as for simulating policy responses in total. Initially it is planned to estimate two choice models for policy analysis:

(a) The work mode choice model

(b) A joint destination mode choice for shopping trips.

Decisions as to further models for analysing other trip purposes, or behaviour in particular contexts of interests will be made in the light of time and resources available and of crucial questions which emerge as the study proceeds. The data base available is thought capable of later application to many other analytical tasks which are outside the scope of the present study.

DATA COLLECTION

The usual range of surveys were required within the brief and all except the Household Interview Survey were conducted along conventional lines and using conventional sampling fractions. In the case of the Household Interview Survey, conventional transport planning practice would call for a sample of 10% of households for a city the size of Canberra. This was rendered impracticable because of the tight constraint on the budget for the study. The brief required interviews to be carried out on a sample of not less than 2,000 households in the study area, and interviews were obtained from approximately 2,200 households, which nevertheless represented less than half of the standard sampling rate for a city of 200,000. Analytical limitations imposed by this are less severe than would have been the case if complete reliance were to be placed on traditional urban transport models, since logit estimation makes it possible to obtain a much higher information yield per observation than is possible from data aggregated to zonal level. Nevertheless a larger sample size would have been preferred had resources been available.

THE HOUSEHOLD SURVEY

The Household Interview Survey merits brief

discussion since it was designed to provide the usual range of household person and trip details, and also to produce some additional information required, either for the present study, or for use in future planning work by the Commission. The extensions to traditional household information were dictated by foreseeable analytic requirements and are thought to include:

(a) The pattern of individual responses to various possible measures designed to reduce private vehicle commuting.

(b) The likely pattern of response on non-worker members of households whose car availability would be increased in the event of a reduction of private vehicle commuting.

(c) Trip making and mode choice changes resulting from future land use or civic design initiatives intended to foster pedestrian and public transport modes.

(d) Changes in town centre planning policies and questions of the stability of the retail and business hierarchy in the event of significant changes in the travel environment or in the scale or location of retail activity.

(e) Responses to measures designed to increase vehicle occupancy by encouraging carpooling or other means, and the likely response to new modes, such as various types of rapid transit, para transit, or ultimately personalised rapid transit.

(f) Evaluation of technological alternatives for the main public transport spine, in response not only to service characteristics, but also to complementary land use and civic design variations.

A judgement was made that given the basic structure of Canberra as it now exists, the ultimate capabilities of public transport are likely to suffer from structural limitations which may be difficult to completely overcome. In the light of this, changes in the pattern of use of private modes are likely to be among the major responses of the system to various policy initiatives. Consequently the arrangements surrounding multiple occupancy private vehicle trips, and factors influencing the propensity to walk may be amongst the more sensitive policy targets for Canberra's transport planners.

The other key consideration was that, in the short-term, and given the limited duration and limited severity of Canberra's current diurnal peaks, any significant change in level of service on the road is more likely to result in *peak spreading*, than in significant mode switching. Factors governing peak spreading through changes of time of work travel therefore become important and were made subject to a specific question. Survey respondents were also asked for an account of *all walk trips*, and for considerable detail on walk elements of work trips.

ECONOMIC EVALUATION

The emphasis in the project is on questions of tuning the existing system. Evaluation requirements for fine tuning decisions are more critical than for the more charac-

teristic transport planning evaluations of the economic merits of construction alternatives against a "do nothing" policy. The policy and management alternatives available in the short-term are likely to be subtle in their implications and customary evaluation procedures are not well adapted to other than broad enumerations of project yield.

The choice of an appropriate "do nothing" case is not only of critical importance, but it also poses practical problems. In a fast growing city, strict interpretation of "do nothing" makes little sense, since obviously some new facilities will be required if only to link in new areas to the existing network. The most obvious base case or "do nothing" alternative would be the continuation of the existing criteria for provision of additional road lanes, parking spaces and transit schedules, but alternatives can be imagined. For analysis of a fine tuning of a system it is necessary that the specification of the "do nothing" case must be detailed and exhaustive, so that small scale, but pervasive changes in usage patterns can be fully elucidated.

The conceptual framework to be used for evaluation closely follows that of Neuburger, "User Benefit in the Evaluation of Transport and Land Use Plans", *Journal of Transport Economics and Policy*, 1971, which makes a clear distinction between perceived user benefits and resource costs and resource savings treating net user benefit as equal to perceived user benefit plus the fall in perceived user costs, minus the fall in resource costs. The consideration of fares and parking charges, taxation, accident costs, facility costs and system operating costs will be approached in a manner similar to that endorsed by the Commonwealth Bureau of Roads. It is hoped that in the treatment of user benefits, the Canberra data will permit an approach which is more sophisticated and complete than that currently in general usage, by

estimating from Canberra data the value of travel time savings to various community groups, at various levels of income, and in various *contexts*.

Rigorous application of the consumer surplus methodology implies that utilities are scaled so as to have equal marginal utilities of money, and as a consequence that the marginal utilities of time are less for low income than for high income people. This leads to the inbuilt result that, other things equal, a project which saves time for the rich will be favoured above one which saves time for the poor. Other approaches can be defended on equity grounds, but it is proposed to use the rigorous approach to evaluation and to rely on commentary, and on side analyses to take account of distributive consequences where there are significant differences between these amongst the policy alternatives under consideration.

Evaluation can be based either directly on logit models for sub-classes of travel and then expanded to describe the total population in a variety of ways, and evaluation of specific policies will probably be approached in this fashion. Overall evaluation of system outcomes are expected to be based on the use of an origin constrained production-distribution model estimated by regression analysis. Different classes of trips are sensitive in different ways to the policy options currently under consideration; in general, trip production and distribution for the journey-to-work can be regarded as highly inelastic in the short to medium-term, but mode changes may be expected in response to certain policies. On the other hand, demand for non-work trips is more elastic overall; highly elastic for certain classes of travel, such as for social and recreational purposes in general, and highly elastic for travel

by housewives as a function of car availability and transit service. While several evaluation tools will be used in the course of the study, some based on disaggregate models and others based on direct demand or aggregate models, overall measures and net social benefit will be required in broad terms for the major policy alternatives. The choice of models as a basis for these remains to be made in the light of results of various elements of the modelling work.

CONCLUSION

The approach adopted in the study derives directly from the policy concerns of the National Capital Development Commission and departs from conventional practice in a variety of ways. It approaches the task as a system utilisation or management exercise, rather than one focused on capacity expansion, and is intended to quantify social consequences of the measures being considered. Informal techniques of public consultation will be used by the National Capital Development Commission in extending the quantitative analysis within the context of this study, to take account of public acceptability.

It is believed that the Canberra STTP is a portent of things to come, in that it is focused on questions of restraint rather than on open-ended traffic growth. It uses a "belt and braces" approach, backing novel modelling techniques with a conventional four-step production distribution and assignment model. It is believed that the use of probabilistic choice models for analysis of policy questions will soon become universal in this country, as appears to be happening in the United States. Behavioural models have made the transition from the research tool of a few years ago, to a routine part of the armoury of transport analysis, and

the Canberra STTP is the first Australian study to use these techniques on other than a localised special context basis.