Institute of Transport Studies
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Consultancy Report

REVIEW OF THE INFORMATION AND MODELLING STRATEGY FOR THE DOT TRANSPORT STUDY GROUP

Report to the NSW Department of Transport

February, 1995

The Department of Transport NSW commissioned the Institute of Transport Studies (ITS) at the University of Sydney to review the data, information and modelling strategy of the Departments Transport Study Group (DTSG), and make appropriate recommendations in each area.

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1. PROJECT OBJECTIVES AND STRUCTURE

The Department of Transport Study Group (DTSG) has been responsible for the NSW strategic transport planning model, and for collecting the data required to apply these models. Since 1971, the key data required has been collected through major surveys carried out every ten years since. Data is currently held for 1971, 1981 and 1991. This process, and the models used to support strategic transport planning, have not changed very much over this period. It has become apparent that the models were not designed to respond to many of the issues now demanding attention, nor is the data required to feed them sufficiently frequently updated to be effective as useful information. The current system satisfies neither the needs of the Department of Transport (DoT) nor many of the stakeholders. DoT requires appropriate information to fulfil its policy and planning functions, and so a new approach was required for the development and direction of DTSG as the key State focus for transport planning information.

A project was therefore set up to review the models and data holdings of the DTSG for the Metropolitan areas of New South Wales, and recommend what would be needed to match current and developing needs, and make effective use of the information obtained.

The project was done in two stages. First, a review of the current resources and development of a strategy and then an outline of the steps required to implement it.

Review tasks:

- Current needs and views of stakeholders,
- Existing model structure,
- Current policy issues and their amenability to modelling,
- Current data holdings at DTSG, and;
- Current world best practice in modelling.

Development tasks:

- A strategy for DTSG's model development, and;
- An action program to realise this strategy.

Establishing the current position

DTSG holds a substantial amount of data. It also has a number of transport and land use models, and a detailed highway and public transport network for urban areas. The technical aspects and documentation of both types of resources were reviewed by ITS. Volume I of the Appendices contains these detailed assessments.

The views and needs of external users and stakeholders are a key part of any such assessment. A series of stakeholder interviews were carried out to canvass their knowledge, requirements, and views on DTSG data and modelling functions.

The current state of the art was determined by direct contact with a sample of modelling and transport model application experts around the world. Their views were sought in a structured manner using the Delphi[1] technique. The detailed stakeholder interviews and the Delphi results are given in Volume II of the Appendices.

A series of workshops was held for mixed groups of technical, policy and specialist people to consider the questions raised by this external input, and to obtain their views and requirements for the future.

2. CONTEXT

The DTSG is responsible to the Department of Transport for collating and managing transport planning, data and the results of analysing such information. This requires DTSG to collect travel information, and to bring together a wide range of planning data and forecasts from other areas of government. A considerable amount of data processing and checking is needed to create a consistent description of the transport environment. Once this has been completed, a series of statistical models can be built and used to assist the strategic planning and coordination of developments in Sydney.

This process creates a major information resource, and the means to apply it to problems or planning. However, this potential capacity is valuable only if:

- The data is of good quality
- The potential users have a good idea of what the data comprises

[1] Delphi is a method of querying experts on their views and feeding back the outcomes in a structured manner to obtain a broad consensus view of the expectations and judgement of the group as a whole.

- The models have the potential to respond to relevant policy changes
- The information is available in a form compatible with the known planning forecasts of development in Sydney
- Access to the information is prompt, well informed and pertinent
- A capacity to use a common base model is made widely available.

Some of these conditions have not been present for some time within the DTSG, and this review of the modelling and information strategy is an opportunity to ensure that realistic client expectations can be met.

The present study has systematically reviewed the views of the many different interested parties. The clients for both the data and the models have been brought together in workshops to help to develop common ground for the future.

Models need to be relevant, pertinent and credible. This required a broad ranging debate with the people at the world state of the art in both the models and in their effective use. This was undertaken using a Delphi process involving people all across the world. These external contacts covered a substantial range of expertise and interests, from local users to international analysis experts. A number of key points emerged from both the Delphi study and the local workshops. In combination they provide an assessment of the market in which DTSG resides, and the types of actions and skills that need to be developed to meet both local goals and international standards.

Models cannot work without data. In the past, major surveys have been done to determine travel demand and movements from place to place. These surveys have been costly, and it took several years before the data became available for use. Surveys provide critical data, but other forms of data are also required, and can be almost equally important. The workshops provided a detailed review from a wide range of stakeholders of what data should be held, and how frequently it then needs to be updated to remain valuable.

Transport, travel understanding and forecasts are now needed in many different types of situations. The policy instruments range from changing hours of work to altered locations of shopping centre destinations, from responses to new patterns of charging for public transport to the systematic management of access by selective road closures

or restrictions, and from the addition of new road capacity to the pricing of new infrastructure.

In addition to this wide range of policy instruments, evaluating the impacts has become more demanding. It is now necessary to assess the effects of transport changes on many different groups of people, to look at environmental and social factors more closely, and to provide a sound, credible and continuing basis for educating and consulting with the community.

This multiplying range of demands is difficult, perhaps impossible, to satisfy using solely the large scale models developed from the 1971-81-91 Travel Surveys. These large scale models are concerned largely with flows of traffic over road networks and the movement of people through the public transport system - but cannot readily adjust the relative importance of one factor or group of people against another, or allow the effects of many current policy instruments to be tested.

A new type of model is clearly needed. One that will respond to many different aspects of people's perceptions as well as changes in fares and costs.

Different models demand different data. Large scale travel surveys undertaken at wide intervals are no longer suitable to respond to such an increasing diversity of demands. Needs change over time, and dictate a move to both more frequent data collection, and to collection of data of a different type. Broader attention to the different purposes of travel is needed, as travel to work has now dropped below 20% of all travel, and closer attention must be paid to nonmotorised modes of travel, changes in the composition of the work force, shifts in employment and times of travel. Broader accessibility measures are needed to assess the effects of transport policy changes on different groups. Models must become capable of responding to a much wider range of possible policy and operational changes than they are now.

The time taken to produce useful results from a modelling analysis must also be greatly reduced. This may require organisational changes, with greater access to operating models on various types of data held at the DTSG in addition to faster processing and more suitable forms of models. This may be needed to avoid the bottlenecks of a single group maintaining the data and both setting up and operating the models.

These emerging requirements are a result of an altered community vision of transport and their living environment. The concerns of the community for environmental protection, and better living conditions lead to strong resistance to infrastructure changes

that are not well explained and promoted to the community. A new modelling and information system is hardly likely to be effective unless some elements of the wider public vision are accepted, and made an intrinsic part of the DTSG data and modelling process. Unless timely responses can be provided to issues with a one year horizon, the ability to implement longer term plans over several years - or even decades - will become progressively harder.

Often what is asked for is a forecast, but what may really be needed is a scenario. A scenario is a complete picture of a possible future situation where all the different effects dovetail to give a consistent overall view of this possible future. A scenario does not predict that this future will occur, but it does show how a range of different interdependent factors constrain what can be achieved. Policy and consultation processes now need both forecasts and scenarios. Unfortunately, the current DTSG models and data are not well suited to producing them.

3. RECOMMENDATIONS

Mission

R1 The DTSG's role should include a commitment to serve the client base through the provision of and access to base travel data, interpretive analysis of such data, projections based on interpretative analysis, and the application, maintenance and development of a strategic model system.

Strategic recommendations

R2 Data collection and modelling must be a continuing and developing process to ensure continuing client relevance

R3 Both data and modelling systems should be reviewed every three years

R4 A GIS framework should be used to integrate the information required

R5 DTSG develop a new strategic modelling system[2] over a three year horizon, to replace the present one

[2] A Strategic Transport and Information Management System (STIMS) and Geographical Information System (GIS)

R6 Models with a wider range of behavioural variables should be used, for greater policy relevance

R7 'What if' data[3] should be collected to assess expected behaviour.

R8 Models must be structured to be able to test a wide range of changes in the transport environment.

R9 Development of the new system should be conducted in parallel with the continued use of the current models, until the new system is operational

R10 DTSG implement a documentation strategy which enables ready identification of relevant data, and informed access to information and to analysis processes by stakeholders

Implementation recommendations

Data

R11 DTSG implement a data strategy of continuous collection of primary and secondary data.

R12 Activity diaries should be used to obtain the key primary data for both commodity and passenger movement, and the coverage should be extended to pick out areas of special interest on a regular basis

R13 A combination of activity diaries and screen line counts should be used to track both commodity and passenger movements

R14 Improved processes for collating secondary data (employment, population etc.) will require close liaison with other Departments

R15 DTSG should set up a strategic modelling and information system (STIMS-GIS) in a geographic information system framework, so that all geographical[4] scales of information are available for analysis and reporting

[3] This can include stated preference surveys, as well as attitudinal and opinion questions

R16 DTSG should set up a computer based information system to communicate the contents, limitations and access provisions for data held by the DTSG, and for referrals where this is an appropriate response.

R17 DoT play an active role in convening seminars or workshops aimed at determining what information is required as a DoT core function, what is value added and what should be supplied or costed as a Community Service Obligation (CSO)

Models

R18 A 3 year program of staged development of a new set of travel, vehicle and location models

R19 Where feasible, new models should replace components of the existing system to provide early gains before transferring to STIMS-GIS

R20 To ensure that STIMS-GIS is operational in the planned period of implementation, it is recommended that a base set of models be developed[5] (Table 5.4). Refinements can occur after the first three-year period

R21 Travel choice models built to forecast trips should be segmented by activity type[6]

R22 Some of the travel, vehicle and location models should combine revealed preference and stated preference data to support policy issues involving 'new' modes or types of proposals, and strategies where attributes are stretched beyond the range of values currently observed.

R23 When the base system is operational, further policy-responsive models[7] should be progressively developed and added

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4 To achieve this it is necessary to store all data and information (including networks) at the most disaggregate spatial level (such as the individual household and business). A GIS platform provides such an opportunity

5 The base models are • trip frequency choice • trip destination choice • line haul mode choice • access mode choice • trip timing choice • fleet size choice • vehicle type choice • passenger vehicle kilometres • residential location choice

6 Examples • passenger movement: • commodity movement • subsistence travel (work, school) • non-discretionary travel (shopping) • discretionary travel (social, recreation)

Usage

R24 Integration of information and response requires an analytical and decision support tool providing[8]:

- Broad end-user access to transport and related geographic and socioeconomic/demographic data (thus a GIS)
- Tools for presenting and visualising transport data
- A complete analytic toolbox of transport analysis methods and models (requiring integration of GIS and modelling tools)
- Ability to integrate further models (ie. an extendable system)

R25 The whole system of models must be built into an interactive and extendable decision support framework[9] to ensure effective and timely responses

R26 The decision support framework must be able to provide both a full *status quo* scenario and provision to define and alter a series of strategies for change

R27 Decision support outputs must include policy-relevant factors (accessibility indices, emission levels etc.) as well as operational measures (modal shares, traffic flows etc.)

R28 Provision must be made for stakeholders to be able to have their own models run by the DTSG[10] using the most detailed level of data available, with provision to audit the outputs to ensure privacy and confidentiality requirements are met in the outputs returned

Documentation

[7] These are • travel • a choice of not travelling at all • trip chaining choice • modal availability • parking choice • goods vehicle kilometres • education location choice • retail location choice • special generators choice • residential dwelling type choice • residential tenure type choice

[8] Systems providing this range of capabilities are now becoming available: Calipers' TransCAD is one, and specialised links between other transport planning and GIS systems are also emerging

[9] The ITS Strategy Simulator is a practical example of such a system

[10] This may not be practicable until the current model has been replaced by a full STIMS-GIS

R29 Internal documentation should be produced to cover procedures for updating and maintenance

R30 Documentation should be produced in a form also suitable to market the content and potential of DTSG holdings, and to ensure that access and usage constraints are clearly communicated.

4. REVIEW OF EXISTING RESOURCES

Models

The current models are little changed from those developed for the 1971 travel surveys. They handle the Sydney region as a series of smaller areas, with road and public transport networks joining them. The models apply only to the morning peak period. Additional models estimate car ownership, work force location and composition and other factors. The whole model system relies heavily on information outside the travel model. Land use development over time, and shifts in employment and residence are crucial areas where what goes in has a major effect on what predictions come out.... and the quality of the information that goes in is often poor.

Changes in working hours and work force composition are hard to handle in the current models, which assume that a peak hour is an appropriate time period to simulate. The changing shape of the peak, and the spreading of activities over the day (and the weekend) and the spreading of shopping and working hours do not fit well with the assumptions of stability built into the current models. It is now necessary to allow changes in the time of departure to be chosen as a response to various changes. The current models cannot do this.

School trips, commercial vehicle trips and trips for other purposes are not differentiated in the current models, highlighting their limitations when dealing with current transport-related problems. The simplified assumptions with which public transport and toll charges must be modelled are increasingly unacceptable.

There are basic problems with the employment modelling. Closer cooperation with planning authorities will be needed to make progress, as both the basic data and forecasts need attention before models can be built to improve this aspect of strategic modelling.

The growing importance of these limitations in the face of changing requirements were a recurrent theme in the series of stakeholder interviews and workshops.

Data

The basic data holdings at the DTSG include household interviews from 1971, 1981 and 1991: ABS Journey to Work data from successive population census surveys, and commercial vehicle surveys from the 1971 and 1991 surveys. A considerable amount of secondary data has been brought together to be able to set up and operate the current models. Other major data holdings, including a large scale STA survey, have not survived successive moves and organisational changes of the group over the years.

Household interview data from the early 1970s for Wollongong, Gosford-Wyong and Newcastle is available from sources outside the DTSG, but not all are complete in the current DTSG internal holdings.

Data is also held in a series of special forms, some of which are derived from the basic data through modelling and model estimation efforts. These include trip tables, road and public transport networks. These are available for the more recent surveys, and the 1981 trip tables have been in steady demand since they were first estimated.

Geocoded boundaries of traffic zones are a recent enhancement of the DTSG data holdings. These have been used to create good quality maps, and build in parts of the DTSG 1991 data into an ArcInfo GIS framework.

Transport studies tend to require special aggregations of areas, and greater detail in one area of interest than in areas further away. As a result there are many different sets of aggregated data and derived results such as networks, trip matrices and estimated forecasts of travel. This makes documentation increasingly complex to maintain, and encourages the use of a GIS framework to handle such aggregations more easily. DTSG's initial efforts in this area need to be given a higher priority.

Documentation

Documentation is needed for both basic and derived data. It is unusual to find documentation for data or models that is both well thought out and up to date. DTSG is no exception. The documentation for the data sets prior to 1991 have suffered from a series of moves of the group. This has caused a considerable number of critical items to be lost or destroyed.

The documentation of the models is perhaps in the best condition, as the models have not changed very much over a very long time. The draft of a full volume describing the 1991 variations of the 1981 model was completed in October 1994.

A major difficulty in documenting the data is that a written description of the items covered in the relevant survey is not enough. The details of the interviewing and coding instructions are also needed to ensure that the data is really what it appears to be. The different forms of storage where the data is kept also need to be closely specified, be they tapes, discs or other forms of machine readable backup.

It now not unusual for data to be held in forms which can no longer be read by most computers. This problem is increasing, and the National Library has a working party actively concerned with the issue of maintaining access to archives held on forms of storage no longer readable using today's computers. This emphasises that data storage for such information is a matter that requires active monitoring over time, and cannot be left to a single backup copy left in case of need some years in the future.

It is the nature of large scale data that errors are found and corrected over time, and so the 'master' information can exist in a number of different forms for different purposes. To avoid the confusion that can arise from this inevitable multiplication of sources, a master copy of the basic data plus the relevant documentation and maps is needed on a CDRom. The current policy of placing all data and error corrections in a single large relational database has made the documentation of the 1981 and 1991 data complex and difficult to communicate, and indeed it is not yet complete in a technical form.

The use of a relational database as the reference master for the data means that the queries required to extract data from the database need to be carefully defined to ensure consistent results from the database as it has been implemented. This inevitably creates a bottleneck in user response as highly specialist staff within DTSG must be used. A simpler version on CDRom, perhaps with restricted coverage, could overcome this bottleneck for many stakeholders.

Data documentation must fulfil several different tasks:

- Define the technical structure of the data
- Specify the meaning of each item and its values

- Describe the connection between the physical data item and the processes required to create it (eg. is it raw basic data? adjusted and corrected data? a trip table estimated in a particular manner?)
- Define how it is stored
- Specify how to extract information from it
- Detail procedures to maintain, copy and backup the data

Modelling documentation requires not only details of how to operate the models, but also specification of the parameters used and how they were estimated for specific runs. Documentation is needed to enable third parties to pose queries to the relational database (RDB) which holds the 1981 and 1991 data, or to execute models themselves. These services will require policy and organisational arrangements which must also be documented.

They may also require a more limited range of data to be held in a simpler form, not directly connected to the DoT database. This would overcome some of the privacy issues, as well as the technical problems of direct access to a more complex database system.

Documentation is a critical factor in the success of any fresh strategy. It is needed to ensure that the information and models can be maintained effectively, that stakeholders know what is possible and how to ask for it, or even to do it. The importance of the promotional and marketing aspects of documentation mean that a searchable information base about the data base is essential.

Fig. 1 is an example of the appearance of such a system, which can contain graphics, details of the range of data items, comments on its reliability and even on its possible potential for stakeholders.

The widespread lack of knowledge of exactly what information DTSG holds, how to get at it, and what it can be used for must be addressed as an urgent matter.

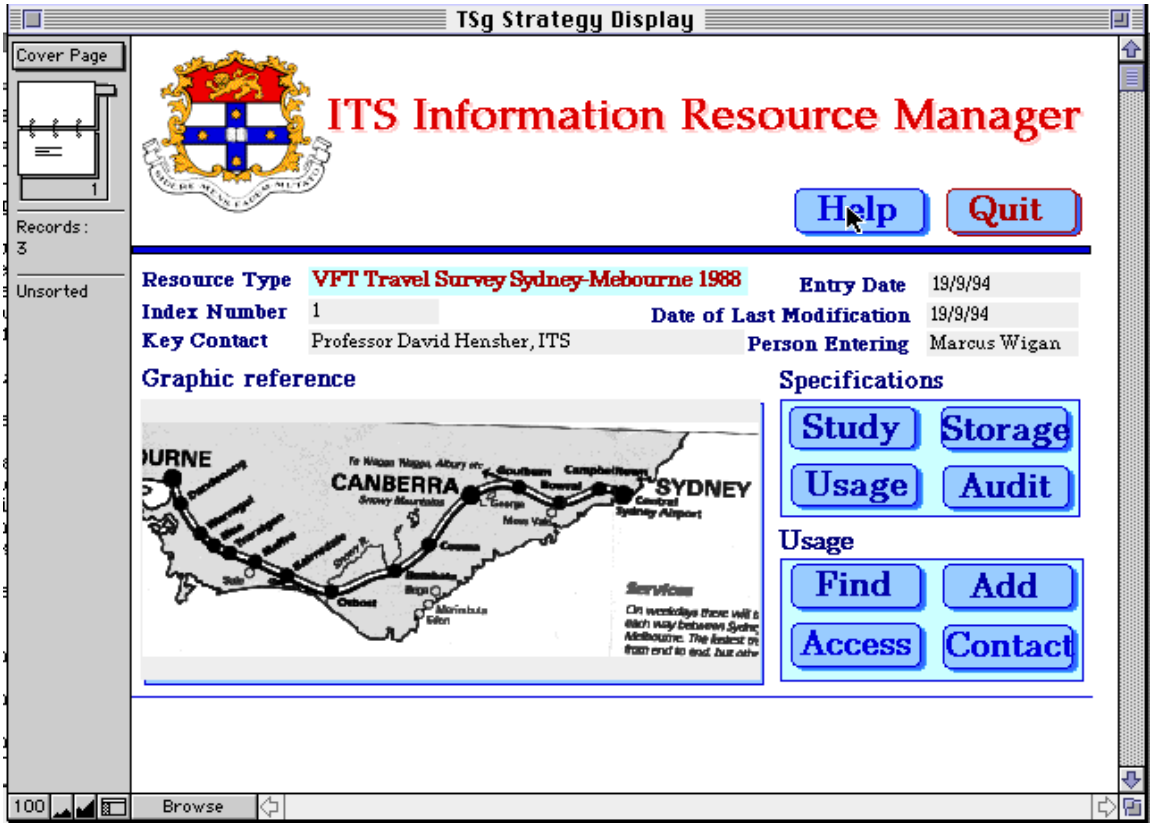

Fig 1. Example of a database to manage information about data sources

5. STAKEHOLDER AND SPECIALIST INPUTS

Stakeholder interviews

Stakeholder discussions revealed a low level of knowledge of DTSG, and its information holdings and activities. A number of concerns over the credibility and accessibility of the models were expressed, and concerns over the problems of obtaining current data. Direct access in some form to a decision support and data system would permit agencies with strong analytical skills to make effective use of these without adding to the demands on the DTSG.

Those aware of the DTSG and its data holdings were concerned about over-reliance on widely spaced major surveys. The limited coverage of non-work, school and commercial travel, and freight movement was becoming significant. A repeated complaint was the inability of the current models to respond to many of the available policy variables, limiting its usefulness substantially. The rapid change in transport, economic and organisational environments was continually mentioned, and the need to have tools and information to match these changing needs.

Improved evaluation methods for environmental factors were needed. The DTSG data collection and modelling systems clearly were expected to support a broader and better founded evaluation framework. This was seen to require new data and some applied research, as well as provision in the new strategic modelling system.

Interpretation of the data was seen to be very valuable. This requires both close knowledge of the data and ready and easy access to it. Much can be done to interpret data before strategic models need to be run. A decision support system could further limit the need to use the full strategic modelling system on every occasion.

The stakeholders were clearly seeking

- Better marketing of the data holdings
- Added value from the interpretation of the data holdings
- Greater access to the information
- Faster response models
- A broader range of alternatives, policy options and evaluation aspects

Delphi responses

The Delphi process is normally run through several cycles, at each stage expert opinion is sought, summarised and fed back. Delphi draws on the finding that group judgement, tapped in this way, is both less conservative and more reliable than individual expert opinion. On this occasion there was time for only two rounds of international responses. The findings were in surprisingly good accord with stakeholder and workshop results. The Delphi process asked for the most important issues in transport and of various aspects of modelling.

The Delphi asked what had been the most important issues in transport in the last five years, what would be the next five years - and what issues ought to be important in the next five years. Fig. 2 summarises the overall expectations for the next five years.

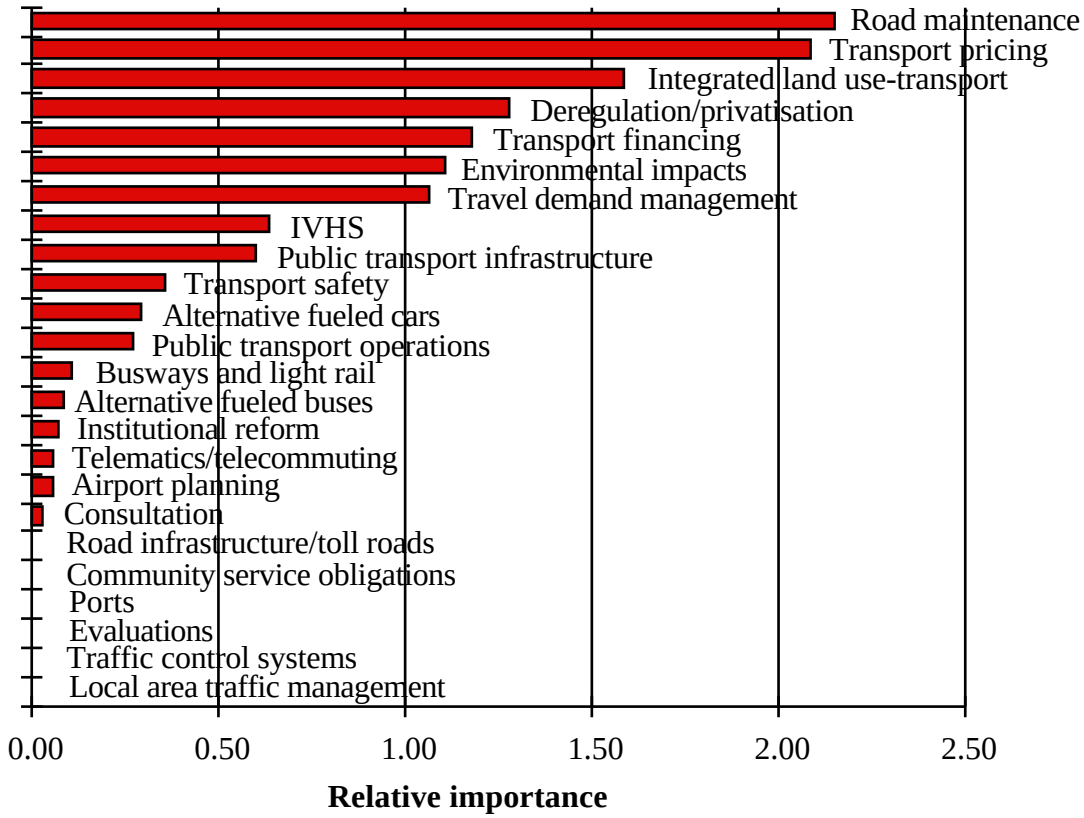

Fig. 2. The expected most important issues for the next five years

The common ground on modelling and data collection issues included a move to continuous surveys, greater use of geographical information systems, monitoring processes as well as forecasting, working on patterns of activities rather than the trips that they serve and the use of stated preference models to expand the range of issues where forecasts could be obtained.

Almost all of these are put forward for the DTSG strategy were rated as achievable by over 90% of respondents. Working with activity patterns rather than trips alone was rated as extremely important. About 80% of respondents rated this as achievable in the short term, reflecting the limited but growing experience in this area and the need for both data and applied research.

Government	Private Data Agencies	Universities
Delays in access	Expense	Lack of documentation
Confidentiality restrictions	Data too specialised	Disorganised approach
Poor staff response	Poor documentation	Inappropriate data
Knowledge of what is available		Uncertain property rights
Expense		

Table 1 Common frustrations accessing data from various agencies (listed in order of frequency of response)

The most contentious and frustrating area for all concerned was access to the information collected. The key problem areas identified are summarised in Table I. Access and property rights and charges are now perhaps the most critical policy issue.

If this problem could be successfully addressed, it would assure a broad range of support and cooperation of many different types of stakeholders, as the data collection, modelling, analysis and applications skills and needs are spread across all sectors. To produce an effective outcome will require all three sectors to participate and take a role in at least one aspect of data collection, holding, analysis and provision.

Workshops

The workshops were presented with the issues raised by the stakeholder interviews. This provided a means of consulting more widely with the user and stakeholder community, and refining the issues raised.

A major theme throughout was the collation, access to and costing of information. It was widely recognised that data from many other areas of government were needed to build effective transport models and understand the environment which transport must serve. Considerable costs were incurred by the inability to access data, requiring additional data to be collected. Options varied from wanting all information to be freely available to restricting access by cost recovery pricing to create a market for the data.

In many areas there is a strong case for a core set of data which is made widely and easily available to all parties. These would include current and forecast trip tables, and other types of information which set a common scene for the transport and planning debate. This has become considerably more important since private finance began to participate in transport infrastructure.

Cases already exist where critical transport data sets collected by private enterprise has been withdrawn from the public debate as a result of commercial agreements. This clearly demonstrates the need for DoT to ensure that a core data set is made widely available in the interests of the community and the government.

Other types of information such as stated preference studies of specific proposals, are clearly added value data, and not part of such an essential and freely available core. Clear and unambiguous guidelines on what is core and what is value added are required.

An integrated depositary of the secondary data required to do transport planning was also seen as a requirement that DTSG could perhaps fulfil. DTSG was seen to have to ensure at least a continuing data exchange and coordination with many Departments, beyond those in the Transport areas, such as Planning and Environment and the ABS.

The actual collection of data, building of models, and perhaps other functions could be done outside DTSG, but the DoT was seen to have a key role in the policy for integrating and making data and models widely available.

6. STATE OF THE ART IN TRAVEL BEHAVIOUR AND FORECASTING MODELS

The models currently used at the DTSG include extensive network models of private and public transport at a fairly fine level of geographical detail. This aspect of the DTSG system is well covered at this level. The models used reflect priorities and concerns that are no longer as appropriate.

As a result the DTSG models used predict changes in travel over these networks of road and transport links were not designed to respond to most of the rapidly increasing range of policies, issues and measures affecting the State. Australia is not the only country to see these changes, and both the global state of the art review and the Delphi consultations confirm this with a major emphasis on choice models and techniques to address these areas. These directions can be seen in Fig. 3.

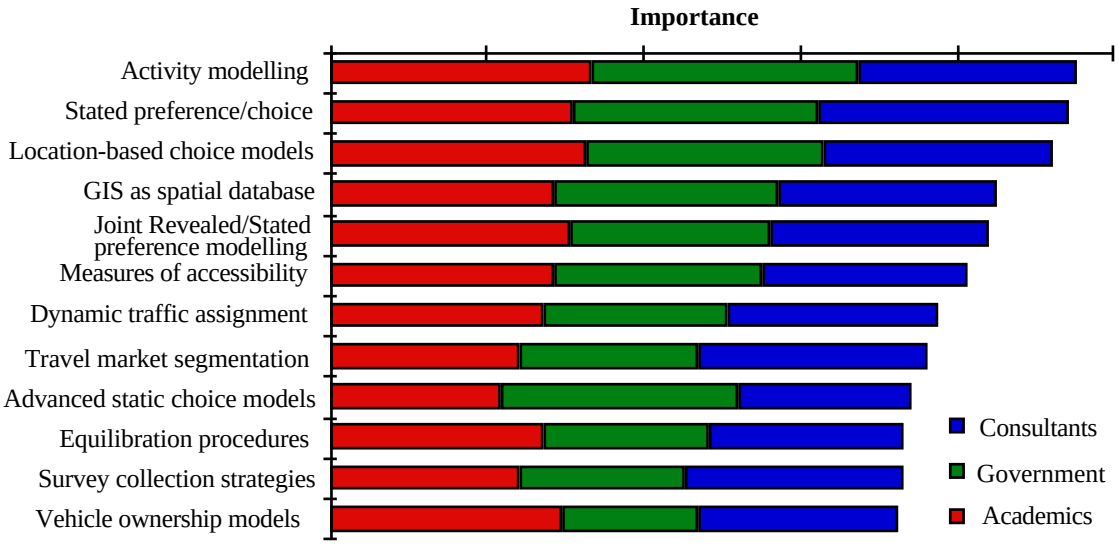

Fig. 3. The top dozen issues raised in transport modelling in the Delphi

The emphasis in travel modelling has moved from direct prediction of traffic flows to a predicting the choices that individuals and organisations are likely to make. This shift has made it possible to consider a far wider range of policy and operational options.

Travel movements are now seen to be the result of the choices that individuals make when faced with alternatives. This means that surveys of choice patterns of a few hundred individuals can give sound predictive results, and the resulting choice models can be applied to a wide range of areas based on knowledge of the numbers of the different types of people there.

This is a totally different approach to the large scale survey designed to obtain detailed knowledge of the geographical movements between many different locations. To do this required very large survey samples, and very limited choice information from each subject.

The shift to individual choice estimation has had three major effects:

- A far closer link to the activity choices made by individuals, which then create a demand for travel

- The ability to estimate models which take account of many different policy sensitive factors

- The ability to build decision support frameworks of a manageable size to examine 'what if?' transport related options, and their likely effects on different groups of people and organisations

Greater Sydney has been divided into about 800 different areas (traffic zones) for the DTSG models. All of the people, premises and households have to be allocated to one of these. This is far too coarse for examining - say - access to bus stops, and yet groups of people have to be aggregated in some way to obtain sensible and reliable models.

Geographical Information Systems allow the exact location of the household, firm, road or facility to be recorded exactly where it is - and yet to be aggregated in a flexible manner which can be different for every use of the GIS. This type of flexibility is now essential, and the integration of GIS with Transport analysis (GIS-T) and environmental planning is growing very swiftly, as it matches the needs of current policy and practice.
The emerging need to know **why** goods are being shipped, **why** people choose to travel at a specified time, **why** employers move to given area, **why** they use a specific freight

transport mode makes it necessary to move more quickly to a greater use of choice models.

The problems of the 1960-70's were concerned with estimating peak demand and predicting what provision should be made for this peak. This led to models designed to estimate the capacity demands for the morning peak. The situation has now changed substantially. Measures designed to make the best use of existing capacity require models that will allow people to change the times at which they travel, and so fixed peak hour models are no longer as important.

The growth in non work travel, flexitime and longer shopping and personal business hours has also shifted the spotlight away from fixed peak hour models or transport capacity, towards choice models to estimate the likely shifts in demand resulting from different management measures. Constraints on individuals take on a new importance, and we need to know more the range of choices that they actually consider .

Intelligent Vehicle Highway Systems are designed to integrate information technology, the transport and the vehicle and the driver/user into a better managed system. It is becoming a major issue on several continents, and Australia and NSW have an active involvement. This approach includes informing drivers where parking places are available, helping them navigate, warning people how far away the next bus might be as well as more technical control systems.

All of these systems are designed to get more capacity or better performance out of the road system, and place fresh demands on modelling the response of the individuals to this new information and wider range of choice, as well as estimating what the new patterns and timings of demand might be. Automatic tolls, area traffic control and road pricing are all options made easier and more acceptable by IVHS, but current models are poorly suited to the task of assessing the effects.

What kinds of data are needed to respond to issues of transport management, mobility and provision? As the issues have broadened, and thrown more weight onto individuals and their choice, it has become clearer that individuals do not necessarily make the same choices year after year. Panels of people have been set up to trace how and when vehicles are acquired or disposed of, what effects the family life cycle has on travel and activity behaviour and how stable travel and location choices remain over time. Consequently, panel survey methods are now being used, and the necessary analysis approaches and models are being developed. This greater appreciation of change has

also led to strong support for collecting travel survey data on a continuous basis, rather than once every ten years.

Just as the problems and data collection approaches have altered, so too have the types of models. Now that individuals are the prime focus of modelling, it is possible to construct models to trace through where the choices made by many individuals in response to changes. Knowledge of the distribution of household and individual types in the population enable these results to be scaled up to represent the community at a strategic level. This approach is called microsimulation, and is ideal for generating and exploring internally-consistent scenarios of possible responses to policy changes.

The combination of choice models, GIS frameworks and microsimulation fills out the spectrum of models required at DTSG, and expands the capacity to analyse, forecast and interpret transport issues and proposals beyond the scope of the current large scale network flow models, which are well suited (and largely limited) to capacity planning issues.

7. DATA COLLECTION ACTIONS

The stakeholder interviews, Delphi surveys and workshops all converged on a number of common points. These were:

- Large scale surveys every ten years were not satisfactory for budgetary, technical relevance and response time reasons

- Continuous survey methods were essential to detect seasonal and other change effects, and to be able to undertake effective special purpose surveys as needed within the survey framework.

- Surveys should collect data on activities that people undertake, not just the trips they report

- The smaller annual samples implied can still produce high quality models and assess choices for 'What If?' studies.

A continuing data collection process will produce less data each year, but this can be highly effectively targeted. Areas where a lot of change is happening can be covered earlier, and more frequently. There are also areas where it is particularly difficult to

predict what will develop, such as some of the fringe areas of Sydney or areas of major redevelopment. Allocating survey efforts on this basis can enhance the quality and relevance of the data collected, and considerably improve the monitoring (see Fig. 4).

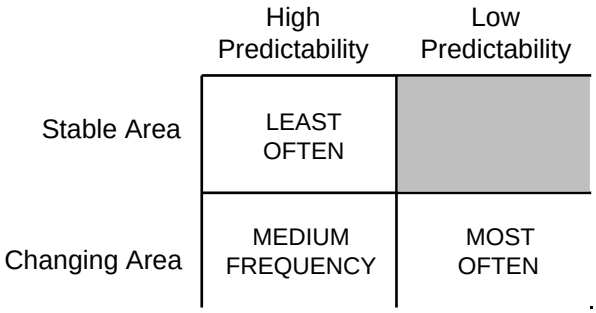

Fig. 4. Allocating survey resources for maximum effectiveness

8. MODELLING DEVELOPMENT ACTIONS

The range of models required for DTSG will cannot be done at once. A program spread over three years is proposed, with each model being tested in conjunction with the current DTSG system until the full range of facilities have been brought into operation. The decision support framework and the models that accumulate within it will run in parallel with the systematic improvement of different aspects of the current DTSG system until then.

The progressive development of a continuing data collection program will parallel this process, and new models and methods will be required as a wider range of choice data is collected.

9. INFORMATION COMMUNICATION ACTIONS

High quality, timely and relevant data collection; well documented data and modelling systems, and fast response models sensitive to policies of real interest are not enough. They provide a solid foundation for a technically effective DTSG, but do little to ensure that the full benefits are realised on the ground.

Two of the recommendations (R16,17) are to ensure that the potential value of DTSG capacities is communicated to the stakeholders. Appropriate data release and pricing

policies should be developed to ensure that the planning and strategy benefits are actually obtained.

A group such as DTSG is in a good position to provide a highly effective referral service both for its own data sources and for those supplied by others. There are problems in making potential users aware of available information, and in particular the technical constraints on its use. If a complex pricing or licensing scheme is envisaged, these problems will become more acute. End users usually want some sort of idea what information may be worth to them, and the means of communicating this can be quite difficult to achieve. Technical staff often do not find it easy to help until a prospective use's questions become reasonably well informed and focussed.

One way of bridging this gap is to create an interactive information resource[11] that can be searched for various combinations of locations and pieces of information, and come up with a number of relevant information sources. Each of these information sources can then be documented to cover areas such as:

- The limitations on its use,
- Special features,
- Access provisions and constraints,
- The forms in which the information can be supplied, and;
- The ways in which analysis can be done on behalf of the user.

Production and distribution of such a system and its updates would be an effective method of raising awareness of what DTSG has to offer, and to focus the resulting queries so that they can be dealt with more effectively.

The production and collation of transport and related data is a key function of the DoT as a State instrumentality. There are, however, several areas of data collection that extend beyond the core necessities of the DoT, and can provide added value to stakeholders at an appropriate cost. A good example of this function is the consortium created by DTSG to obtain and supply detailed the 1991 ABS Journey to Work data.

[11] A system of this type has recently been built by ITS for the RTA to help to raise the level of knowledge and access to information about nonmotorised transport. Fig. 1 illustrates the appearance of such a system.

The stakeholder interviews revealed a substantial amount of wasteful duplication of data collection in transport sector, and the real lack of a clearinghouse for relevant public sector data. DTSG provides a technically oriented focus which should be capable of interpreting, assessing and qualifying the utility of data of various types, and is certainly an appropriate body to manage such a function if it is outsourced.

The basic data critical to the functions of DoT could arguably be made widely available[1 2] in a standardised bulk format (such as a CDRom) at a marginal cost. This would meet many of the problems, and reduce much of the costs reported by stakeholders. The processed data in various forms are added value products. Some of these should be used for marketing the understanding of the transport environment as a responsibility of DoT, and others could be made available at an appropriate charge.

Where the boundaries should be set between core and value added is a matter for DoT and government policy. However, it is clear that a substantial waste of public resources can and has occurred due to limited availability and thus restricted credibility of this type of transport data. This has occurred by duplicated travel data collection within the public sector. Potentially more serious, costly Public Inquiries where the lack of a publicly available and credible common ground of data led to additional costs to the community and to the parties concerned.

In spite of this, the effectiveness of the public debate was reduced due to these conflicting data sources and technical submissions. The ready availability of a common core data set would permit peer review and interpretation of much of the data at no cost to the government, and thereby set a higher floor for public debate.

This would lead to lower costs, and Inquiries focussed more on the issues of tradeoffs between benefits and costs to various groups and the community within a broadly credible and accepted informed strategy.

This situation demonstrates that some of the value-added DoT data should be provided at marginal cost as a CSO, in view of the reduced overall community cost and more credible consultation process that results.

These points have been raised in the interests of maximising the effectiveness and the leading and enabling role of the DoT, to reduce delays in the decision making and

[1 2] Subject to privacy and confidentiality requirements to avoid identification of individuals

consultation processes and to make proposals that produce the lowest overall costs to the community as a whole.

Few of these issues have been publicly debated in a balanced and informed manner, and it would be appropriate for the DoT to take a leading role in initiating this debate to inform DoT polices in this area. The effectiveness of the DTSG information strategy will be strongly affected by the outcome.

10. IMMEDIATE STEPS AND RESOURCES

The strategy espoused in this report is strongly supported by both the local and international professional communities, as represented by the stakeholder interviews, the workshops and the Delphi surveys. The recommended strategy is to treat the information and modelling program as a continuing process. The three major elements are:

- Data collection
- Improved model construction and use, and;
- Wide communication of both the resources available and a flow of interpreted results

The immediate first steps are therefore:

- Start the design of the data collection and documentation framework
- Develop an improved modal split model to enhance the value of the recent 1991 data
- Distribute details of this strategy, and descriptive results from the 1991 survey

To ensure that these and later tasks can be undertaken effectively and without delays, DTSG should ensure that the major transport, economic, statistical and presentation software such as SPSS[13] is obtained (where not already held), and suitable devices for distribution[14] of data and information are obtained and installed.

[13] These include SPSS (a fundemental requirement for client communciation and internal usage), Statgraphics, Canvas, Photoshop, Limdep, Pagemaker, Quark Express, Statistica, Deltagraph, Emme/2, Transcad, MapInfo, ArcInfo

[14] These should include a CD Rom writer

APPENDICES

Appendix 1: Contents of Volume I

RESOURCES REVIEW, MODELLING AND DATA STRATEGY PROPOSED

Summary

Appendix 2: Contents of Volume II

STAKEHOLDER AND DELPHI CONSULTATIONS, DATA OWNERSHIP, PANELS AND OTHER ISSUES

Appendix