GOING PLATINUM!
A new approach to transport modelling in Perth

An independent review of transport modelling in Perth, Western Australia (WA), has recommended the implementation of a new approach, harnessing state-of-the-art innovations already in practice elsewhere in the world and in Australia, to address the particular growing needs of Perth.

TRANSPORT MODELLING INFLUENCES CITY INVESTMENT DECISIONS

Behind major infrastructure investment and development decisions such as the Airport rail line, Max Light Rail Transit system, Swan Valley Bypass, Elizabeth Quay and the Murdoch Activity Centre, is transport modelling. In addition to evaluating the transport impacts of specific projects, transport modelling is used as the basis of predicting the impacts of land use and transport plans, policies and programs at the regional and more local levels. But besides influencing strategic decisions, transport modelling is used at the operational level to improve the efficiency of the transport systems through testing alternative solutions for network operations, intersection upgrading, traffic signalling, improved safety and blackspot eradication.

If transport modelling is so influential in determining what gets built in our city, or not, we better be getting it right. While it is agreed that:

“Prediction is very difficult, especially if it’s about the future” (Nils Bohr, Nobel laureate in Physics)

and

“Remember that all models are wrong: the practical question is how wrong do they have to be to not be useful” (George Box and Norman Draper in “Empirical Model-Building and Response Surfaces”, p.74),

it is also concurred with that

“It is far better to foresee even without certainty than not to foresee at all” (Henri Poincare in “The Foundations of Science”, p. 129).

NEED FOR PREDICTING IMPACTS

Transport, communications, utility networks and land-use are classified as the most permanent elements of the physical urban system with a “very slow” rate of change (Wegener 2004). Large infrastructure projects require a decade or more to implement and once in place are rarely abandoned. The land-use distribution is equally stable, only changing incrementally. This permanence, together with significant capital and ongoing operating costs, makes land-use and transport infrastructure decisions particularly critical for city managers. Understanding the potential impacts before committing to the investment becomes an important part of the decision-making process. Impact assessment supported by modelling is often a requirement for infrastructure funding applications.

But what type of impacts?

Transport models, together with their associated land-use models, generally generate a set of land-use, transport and accessibility impact indicators (e.g. land-use and prices, transport volumes, mode share and distribution over time and space, travel time and cost savings), which are then further used to calculate a range of economic, ecological and social indicators, usually integrated into some form of overall measure of impact using cost-benefit analysis or multi-criteria evaluation (Geurs and van Wee 2004).
CHALLENGES OF PREDICTING IMPACTS

The arrangement of land uses in a city influences people and goods movement patterns. Reciprocally, the transport system, built to facilitate that movement, influences land-use patterns. At the same time, a multitude of other factors, interacting in complex ways, also affect the development of a city. For city decision-makers and managers, who need to plan and prioritise what should be done to maintain and improve urban performance, evaluating the potential impacts of particular projects, policies and plans are required. Predicting these impacts is difficult due to the number and the limited understanding and predictability of behavioural responses, to the complex interrelationships and speed of change differences between urban system variables. The further into the future the prediction is for, the more difficult the task and uncertain the results.

Despite these difficulties, and in the absence of a more reliable method, transport models, often linked with associated land-use models, predict and evaluate impacts using mathematical models to simulate human decision-making and its consequences. Other ways of predicting impacts is to ask people about their anticipated reaction to planned changes such as increased transport costs or land-use restrictions or to subject them to experiments designed around hypothetical changes (“stated preference” methods) or drawing conclusions from empirically observed behaviour of people (“revealed preference” methods). All three approaches have limitations but mathematical models are the only method which can predict still unknown situations and determine the effect of a single factor while keeping others constant (Wegener 2004).

LIMITATIONS OF MODELLING

Since their earliest forms, transport models have been criticised largely on the basis of insufficient theoretical underpinnings, excessive computational and/or data requirements and intractability (“black-box” nature). Whilst computational issues have been addressed to a degree, the current challenges in urban model development are:

- responsiveness to policy shifts away from a narrow focus on road capacity to a more complex policy environment including:
  - a more multi-modal approach including non-motorised and transit modes;
  - demand-side policies and their interactions – system management techniques, such as ramp metering; travel demand management, such as congestion pricing; and land-use policies, such as urban growth boundaries;
- strengthening model foundations in behavioural theory;
- facilitating participation in testing and evaluating alternative policy strategies (Waddell and Ulfarsson 2004).

MODELLING ADVANCES IN PRACTICE

In the last decade there has been significant progress in academia and in practice in overcoming some of these recognised limitations. Many advances are still in the realm of the R&D and have not yet been fully calibrated and validated in practice, but a number of innovations have been implemented in progressive cities around the world. Key state-of-the-art trends in practice include:

- improved feedback between land-use and transport models;
- replacement of the trip-based modelling approach with a trip-based schema;
- simultaneous mode and destination choice, giving logsum benefits;
- time-of-day modelling;
- static traffic assignment as a base case;
- hybrid mesoscopic and microscopic modelling; and
- increased focus on detailed modelling of traffic streams.

- greater disaggregation of demand by household type, travel purpose and other input variables, to enable discrete choice modelling formulations for destination, mode and departure time choice;
- dynamic traffic assignment (DTA), including alternative formulations of dynamic equilibrium, non-equilibrium and quasi-dynamic assignment, which enable modelling of delays, queuing and congestion dynamics;
- for large urban areas, mesoscopic traffic assignment models, including ‘hybrid’ modelling capability so that small parts of the entire network can be modelled microscopically in the meso model, on a ‘case by case’ or ‘project specific’ basis; and
- improved freight models as an integral part of strategic transport models, but still hampered by the lack of suitable and reliable freight-specific data and very few cases of application in practice.
REVIEW OF TRANSPORT MODELLING IN PERTH

In order to harness these recent advances in transport modelling to address the unique and growing challenges of transport modelling in the Perth metropolitan area, an independent review of transport modelling was initiated.

Responding to transport modelling needs, capabilities and gaps, identified through a rigorous transport modelling stakeholder engagement process, the review examined current transport modelling practices in Perth, benchmarking them against best practice in Australia and overseas. Offering a framework for the evaluation of modelling approaches, a comparison of the two current, more strategic transport models, operated by the state government, with other approaches in operation around the world, the review developed and analysed three possible options for model development, suggesting a pathway for a new best practice approach for implementation.

Specific objectives of the review were to address the identified needs relating to:

- the place and application of macroscopic, mesoscopic and microscopic models;
- incorporating land freight movements into the integrated transport model;
- land-use and transport interaction;
- land-use inputs and other data requirements;
- level of disaggregation and segmentation – scale, zonal, socio-economic and modal attributes;
- incorporating behavioural responses to policies and demand management measures; and
- incorporating dynamics (treatment of time).

Current Modelling for Perth

There are essentially two strategic transport models in operation in Perth. The Strategic Transport Evaluation Model (STEM) is used to assess the impacts of alternative land-use scenarios on Perth’s multimodal transport systems. There are currently two versions of STEM in existence – one using the EMME/2 software platform and the other, the Cube Voyager platform. The outputs of STEM are flows of vehicles and travellers per mode at the cordon or screenline level, and measures of the performance of the metropolitan transport system in terms of economic efficiency, social impact and broad environmental impact. STEM also provides several accessibility indicators.

The Regional Operations Model (ROM24) is suitable for more specific studies of traffic impacts of road infrastructure projects, land-use developments and metropolitan-wide area traffic management measures. It is also used to provide traffic volume data for use in the planning and design of elements of the road traffic system, such as interchanges and intersections. It is built using the CUBE/TRIPS software platform. The ROM24 outputs are flows of vehicles at the network link level, and measures of metropolitan road network performance in terms of economic efficiency. Outputs may also be used in evaluating social and environmental impact.

Options for Harnessing Innovation

Three options for model development to address needs on the basis of current state-of-the-art international advances in transport modelling were identified and evaluated:

1. continued (separate) development of both STEM and ROM24 models, providing specialised services to current clients, but with improved integration;
2. gradual development into a single modelling system, which incorporates the top features of the current two models, plus additional best practice developments;
3. development of a new best practice modelling system, with strong feedbacks from the transport model to the land-use model and from the dynamic traffic assignment to the previous stages of the strategic model, also integrating a freight component.
INTRODUCING PLATINUM

The third option, named “PLATINUM”, was recommended as the preferred solution for addressing the modelling needs in WA, in line with best international practice and also avoiding duplication and other resource inefficiencies, yet not impeding specialised and advanced work already underway by the ROM24 and STEM modelling teams (Taplin et al. 2004).

The proposed Perth Land and Transport Integrated Urban Model (PLATINUM) is a closely coupled, system of models, exchanging information among them, comprising:

- a five-step, tour-based multi-modal strategic transport model, supported by a land-use model and outputting to a regional impacts model, for use in long-range planning, scenario analysis and system wide transport policy analysis, also providing road passenger/vehicle O-D matrices, by time of day and for planning horizon years to the road transport model;
- a hybrid meso-micro assignment, road transport model of the metropolitan road network including all road-based travel by time of day, and delivering results to a local area impacts model, for use in route planning and evaluation, traffic management and control, congestion management, local area traffic impacts, event planning and incident management planning, as well as providing information on network travel times, delays and queuing as input to the strategic model;
- an external travel model, interacting with the WA Statewide Transport Model; and
- a freight transport model, comprising an improved Freight Movement Model and a separate model for light goods vehicles.

DEVELOPING A NEW MODEL

Development of PLATINUM requires:

a) specification or re-specification of several current model components and alignment of data (consolidate the current 1,500 zones STEM and ROM24 networks, document, unpack/revise MLUFSs);

b) enhancements to the current models (higher granularity in capturing travel behaviour through additional household types, travel purposes, by time of day, using tours instead of trips, and updating parameters of the mode choice model (including travel time variability, crowding and perhaps estimating new models of destination choice); and

c) creation of new component models (including departure time, using a hybrid meso-micro dynamic traffic assignment model of all road-based travel by time of day, considering quasi-dynamic traffic assignment as a better starting point for meso-simulation, a new model assessing wider benefits of projects, feedback to land-use, and authentic integration of all components).

With these specifications, PLATINUM holds the promise of becoming a best practice suite, fit-for-purpose, flexible, and able to address the current gaps and future needs. PLATINUM is expected to be highly responsive to policy changes, provided that the data associated with the model is secured and that calibration and validation of all model components, essential for model credibility, is achieved.

Although substantial additional resources are required to meet the new model requirements, this approach is expected to maximise the use of available modelling resources, provide a greater span in modelling capability and the opportunity to extend that capability to meet future modelling challenges in WA.

Reference notes


