NATIONAL TRANSPORT MODEL DEVELOPMENT

RELATING TRANSPORT FORECASTS TO ECONOMIC PERFORMANCE

Abstract

The paper describes current transport modelling practice in New Zealand, and the need for this to inform and support the development of policies and strategies. The best current approaches in New Zealand are represented by multi-modal strategic models in the main metropolitan areas, but even these have limitations, and there are few techniques that can be used for inter-regional and national transport planning. The paper describes recent scoping work to develop a national transport model for New Zealand and describes the types of strategic techniques needed to produce short, medium and long term transport forecasts. The need to assess alternative transport policies and strategies against economic performance criteria is emphasised in the paper.

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CONTENTS

1 INTRODUCTION

Approach of this paper

This paper focuses on the contribution that modelling could make to the development of more effective transport investment programmes.

First some questions?

- Why bother with models at all and what can they offer?
- Why have a national model and what would it tell us that we can't learn from existing regional and local models?
- What have models got to do with economic growth?

The paper addresses these questions by discussing: the potential of models (section 2), the role of different model types (section 3), what value a national model would have for New Zealand (section 4) and what modelling could do to assist economic performance (section 5), conclusions are drawn in section 6.

Background

The paper has been written as a result of recent reviews of regional and local models and associated model scoping research. This resulted in the development of a simplified model to test policy and strategy options (reference TFL, 2009)

The work undertaken indicates that current transport investment programmes effectively represent 'business as usual' type strategies that (relative to current conditions) are likely to lead to a continuation of recent transport trends, namely:

- Continued growth in road vehicle traffic, with associated increased congestion, increased travel times and growth in greenhouse gas emissions.
- Road crash fatalities and casualties may stabilize, or vary slightly from their current levels.
- Air pollution is expected to reduce significantly, mainly as a result of improved vehicle technology.

The ability to forecast significant changes in these trends, due to the range of policies and strategies that most regional and local models are capable of dealing with, is very limited.

As a result of research to develop an extended modelling capability, combinations of different policies and strategies have been identified that could (if implemented) result in a significant improvement in current trends.

2 THE POTENTIAL OF MODELS

When are models required?

Modelling is a tool that can assist decision-making, although by itself it cannot deliver a project, programme or implement an intervention. Further the success of an intervention depends on a number of factors that are outside the control of transport modelling. Modelling must therefore be seen in this supportive rather than in a leading context and a number of other tools are required to ensure the successful implementation of interventions or programmes.

Modelling is often used to test the effects of particular projects, programmes or interventions and modelling also has a valuable potential role in supporting the development of transport policies and strategies - which in turn are needed to achieve objectives, such as the promotion of economic growth.

- Policies direct the effort of the transport sector towards defined objectives, whatever these might be (for example to promote economic growth).
- Strategies organise the way policies are implemented, and ensure that actions are complementary rather than contradictory.

As a first step in developing policies and strategies, it is important to clearly define the task in hand. This starts with clarifying the task purpose, the scope of the issues or problems being considered and the nature of the objectives being addressed. It is only once the purpose, scope and objectives are thoroughly understood, that data and analytical requirements can be determined and specific modelling requirements can be identified.

To be effective, the development of policies and strategies (and for that matter all other transport tasks, including model specification) needs to occur within the context of an overall assessment and evaluation framework (DfT (1), 2009).

It is of course possible to produce transport policies and strategies without recourse to modelling, but this is likely to result in policies and strategies that are ineffective, short-lived with unintended or even counter-productive consequences. If modelling is not used, this is likely to mean that many objectives will not be realised

Conversely, if suitable models are identified and appropriately used, this will inform and assist the development of effective transport policies and strategies.

Understanding and use of models

Modelling often plays some part in the development of transport policies and strategies, but the use of modelling, in practice, is rarely optimal. This is partly because modelling is often perceived to be a difficult subject, with a variable level of understanding amongst transport professionals.

Despite this problem, the forecasts provided by models are very much needed to provide a quantified and ‘common’ overview of future transport conditions and associated effects.

It is important to appreciate that the output from most models can be produced in easily understood summary formats, and can provide useful forecasts of many aspects of policy and strategy performance.

It is important to also acknowledge the limitations of modelling, especially when forecasting future outcomes. For example, many models rely on historical trend and other hypothetical relationships, which may or may not always hold in the future. Further, when forecasts of input parameters are required to generate the required forecasts, the accuracy of these forecasts will depend on the quality of the input forecasts.

To use the output from models successfully, some appreciation of the type of potential modelling techniques available is required, along with an outline understanding of the capability and suitability of models for different tasks, circumstances and challenges.

3 TYPES OF MODEL

Conventional transport models

Conventional transport models are the dominant form of model used in transport planning. They describe current levels of demand, replicate current movement patterns and define system capacities, in order to form a detailed representation of a transport system for analysis and forecasting purposes. Conventional transport models provide a potentially powerful resource, although they can also have substantial limitations in terms of their 'suitability and responsiveness' for policy and strategy development purposes.

The 'classical' transport model consists of four main stages, namely: attraction/generation, distribution, mode choice and assignment. Due to their structure, conventional transport models tend to be most useful for analysing current conditions, forecasting the effect of future 'business as usual' type strategies and for testing the performance of network improvement options. These models are predominantly applied for detailed planning and programming investment decisions. There is significant potential for this type of model to play an increased role in policy and strategy development when more 'strategic characteristics' are incorporated in their construction.

However, even if conventional transport models were extended in capability terms, some policy and strategy options would remain very difficult to test using a four stage approach. Therefore, conventional transport models will often need to be supplemented by other techniques, when assessing the effects of transport policies and strategies.

Simplified models

Simplified models are highly aggregated representations of the transport system with an ability to respond to changes in policies or strategies, and to forecast the resulting variations in demand (Ortuzar and Willumsen, 2006). This means that a broader range of policy and strategy options testing can be undertaken, for example changes in pricing or behavioural measures, than may be possible by using conventional transport models.

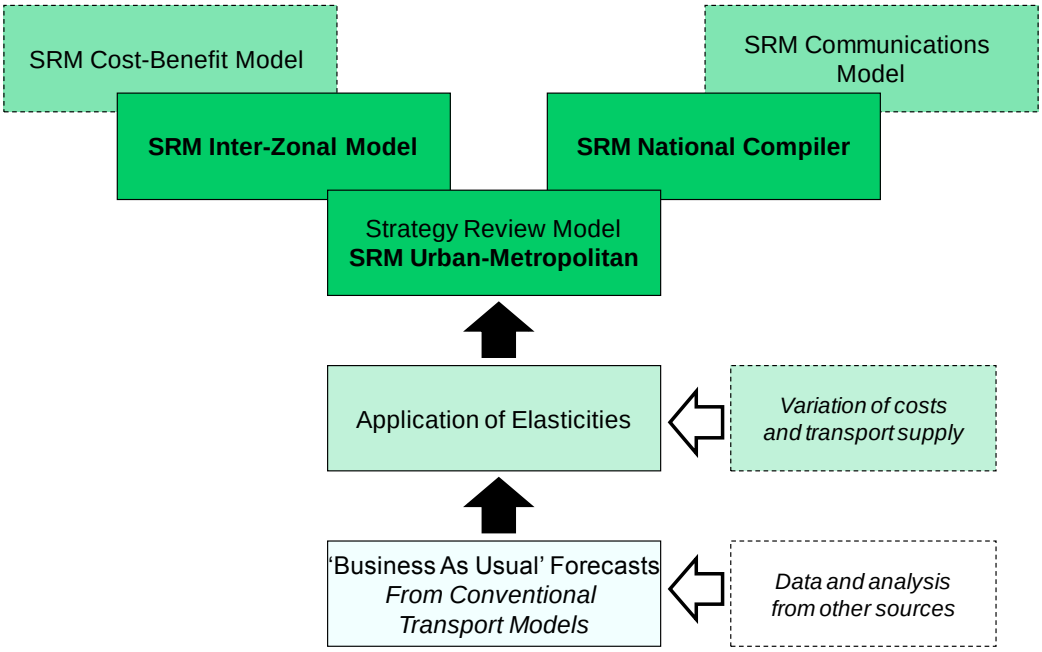
Simplified models can be constructed using a variety of source material, depending on the required purpose and the availability of data. These models also have the potential to provide a more rapid, flexible and cost effective testing capability, than is likely to be achievable using conventional transport models.

Simplified models are likely to be of most value if they provide an overview of transport issues, make model techniques more accessible and deal with pricing and behavioural issues better than alternative calculation methods.

Despite these potential benefits it must be emphasised that any model is only as good as the assumptions it is based on. A model based on incorrect assumptions will give incorrect results. It is also difficult to predict the effect of things that have not been done before in New Zealand, and applying assumptions used in other countries must be done appropriately. All of this serves as a reminder to exercise care in the development and application of models. Peer review is an important component of model development, especially where innovation is involved.

An example of a simplified model, the Strategy Review Model (TFL, 2009), has been constructed in New Zealand. This model illustrates a way of using outputs from conventional 'four stage' transport models to provide a more flexible 'fifth stage', testing tool and this has been used to assist in the development of a number of transport policies, strategies and package related studies. The model consists of a series of linked modules (Figure 1) that have been applied at the national, regional and corridor scales.

Figure 1: Strategy Review Model (SRM) Components



Other models

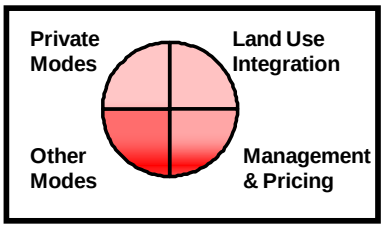
Interactive land use models can also play an important role in integrated land use and transport planning (Chan, 2005: Timmermans, 2003). These models are potentially useful in testing the linkages between transport and economic activity, although to a large extent interactive land use models remain experimental in nature and as a result are rarely used in practice.

If an interactive land use model is not used, it is still important to test the effects of alternative land use patterns in transport terms, prior to developing transport 'solutions' to a given land use pattern.

Educational type models are very helpful in developing mental models (Hensher, 2007) of transport behaviour. These models are also important for professional training purposes and to act as learning tools for decision makers (EC, 2003).

The role that various model types may play in the development of policies and strategies is suggested below (Furnish and Wignall, 2009).

Figure 2: Role of models in policy and strategy development



	Model Type	Strategy Development	Policy Development
	Educational	⊕	⊕
Simplified Models	Simplified Demand	◔	◔
	Structural	⊕	◔
	Sketch	◔	◔
	Land Use	◔	◔
Conventional Models	4 Stage	◔	⊕
	Assignment	◔	⊕
	Operational	⊕	⊕

4 THE CONCEPT OF A NATIONAL MODEL

Most model applications are at the regional, urban or project transport scales. However, for policy and strategy development purposes it is also important that a multi-region or national scale option testing capability is available to forecast overall effects and longer distance movements.

New Zealand does not currently have a national transport model, although some spreadsheet models have been developed centrally for specific purposes. These include, a national vehicle fleet emissions model (VFEM), a national land transport fund (NLTF) forecasting model and a national tourist demand model. These models are very useful for their intended purpose, but do not address the full range of policy and strategy issues and are not widely available.

Various other national scale models have been developed in the past, including a national safety model, a national freight model, a rail emissions model and a state highways model, but none of these are currently operational.

The development of a national transport model requires careful consideration, especially in terms of purpose, scope, type, modal representation and level of zonal and network aggregation (Lundqvist, 2002: Land Transport NZ, 2007).

For example, a national 'network' model could take the form of a conventional transport model and represent trips between zones. If so it is likely to be helpful in terms of representing longer distance movements, but would have difficulty in adequately representing local trips, which make up the overwhelming majority of journeys. The coarse nature of such a model would mean that, it could not be used for network capacity assessment purposes.

Other approaches for multi-region or national scale modelling include:

- An operational 'traffic' based model (for each mode) to represent all movements on selected networks for validation and use for capacity analysis purposes.
- A conceptual national model, similar to the approach in the UK (DfT (2), 2009) or through a summary type technique, such as used by the SRM National Compiler (TFL, 2009)

At the national level, for illustrative purposes only, an interactive educational model has been developed, to demonstrate a range of policy and strategy options, called the SRM Communications Model, and which can be accessed from the SmartMovez web site (NZTA, 2009) or directly at: http://www.transportfutures.net/CommunicationsModelV_PA_1.html

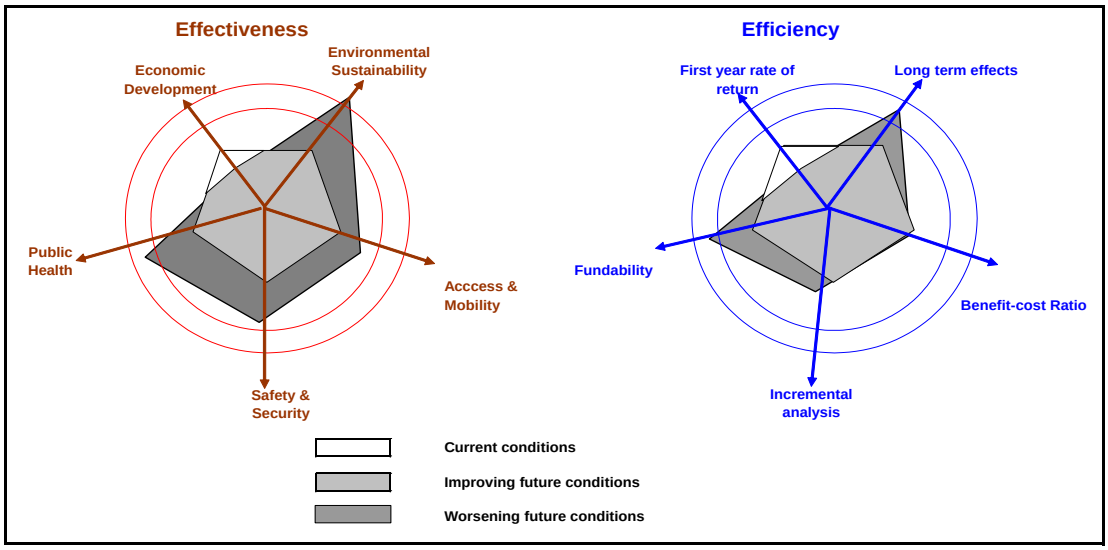
Figure 3 : SRM communications Model – Public Transport

5 MODELS AND ECONOMIC PERFORMANCE

Models can identify whether or not the substantial national resources planned to be used for transport purposes are likely to be effective. For example, if the majority of expenditure was (say) to be directed to reducing congestion and travel times, but monitoring indicated trends of increasing congestion and travel times – and modelled forecasts predicted that these trends would continue indefinitely into the future – would this generate concern that expenditure could be better directed - and that a better economic return on investment obtained?

Models can tell us a lot about the likely effectiveness (or otherwise) of investment programmes, especially in terms of gauging the investment efficiency of policies, strategies and projects, as illustrated below.

Figure 4: Forecasting Effectiveness and Efficiency



However, even most sophisticated models have limitations and models cannot be used to provide guidance on all aspects of the linkages between transport and economic growth. In particular, care should be taken when interpreting modelling results , for example:

- Not all spending on transport (or on roads) will significantly assist economic growth and this means that carefully targeted measures are required to achieve economic objectives (MED, 2003).
- Even where transport investment does facilitate significant economic growth, the question needs to be asked, is a particular investment the 'optimal' way of facilitating growth? For example, induced traffic can erode economic benefits significantly (DfT, 1994)
- It is also true that there is often (but not always) a correlation between GDP growth and traffic growth (Heriot Watt, 2006). However, the strength of this relationship may vary significantly over time and the stimulation or reduction of traffic growth will not necessarily have a significant effect on overall GDP growth. This is because, although different types of programmes are likely to have impacts within the transport sector, these are likely to be small in terms of the performance of the economy as a whole.
- Models are often used to provide input data for cost benefit analysis and if done comprehensively, can capture most if not all economic benefits (Land Transport NZ, 2009). However, cost benefit analysis is rarely undertaken on a comprehensive basis and therefore supplementary techniques are often required to assess overall economic effects.

Models are potentially helpful at all economic scales, including local areas, corridors, regions and at the national scale, to establish the current and future operational performance of the transport system and to test the effectiveness and efficiency of policy, strategy and project options.

Wider economic benefits can also be modelled using regional input-output models, general equilibrium models, interactive land-use activity models, urban development models or

other economic models (TRB, 2000) Where such models are developed, it is important that potential linkages with transport models and their estimates of economic effects are explored. In combination, economic and transport modelling could potentially provide forecasts of regional macroeconomic performance.

A national perspective is particularly important for considering overall performance criteria, especially as the standard of local and regional modelling is highly variable, and also to inform central planning and investment priorities.

The current global economic downturn has demonstrated that models need to have the potential to deal with the risk and uncertainty associated with decision making and that conventional transport models, because of their fairly fixed nature, require supplementary and simplified modelling for sensitivity testing purposes. In short, *…'better modelling...*' leads to …*'better investment decisions'…* (DfT (3), 2009)

6 CONCLUSIONS

Models are required in order to develop effective and lasting transport policies and strategies, without which economic growth and other objectives are unlikely to be achieved. Furthermore, models will be most effective if professionals have easy access to model outputs, to help inform and support future policy and strategy development.

Conventional transport models are very useful for network planning and project options testing. There is considerable potential to improve conventional transport models to make them more suitable for policy and strategy development and such improvements would be very worthwhile. However, even if all conceivable improvements were made to conventional transport models they would still not be able to address all required policy and strategy issues. There is often a need to employ supplementary and simplified modelling techniques to address the structural problems associated with conventional transport models. Simplified modelling techniques also have the potential to engage a wider professional audience and to assist decision makers.

National transport models are required to provide the centre with the overall 'big picture', to estimate the effectiveness of future transport policies and strategies, and to establish planning and investment priorities.

Models can tell us a lot about the effectiveness (or otherwise) of investment programmes especially if the modelled outputs can be used to represent proxy performance indicators for objectives, including the promotion of economic growth. Models are also able to provide useful inputs for cost benefit analysis purposes to gauge the investment efficiency of policies, strategies and projects. However, the linkages between transport and the economy need to be carefully considered and there is no automatic connection between spending on transport (or roads) and economic performance. Good targeting of appropriate investments is required to achieve objectives.

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