Introduction

There have been substantial changes in transport strategy directions over the past decade, with major changes in both the implicit and explicit objectives and targets to be achieved by and through transport. These have not, by and large, been matched by improvements in the information and techniques available to assess policies, programs and projects or in the allocation of funding to transport initiatives

The Transport Infrastructure Intelligent Relational Information System (TIIRIS) has been designed as a decision-support tool that will allow planners and decision-makers to focus on outcomes rather than outputs (ie achievements through transport) rather than just achievements in transport). Its focus is on a strategic asset management approach to investment, encompassing demand-management and use-management as well as 'build' solutions, and the identification of innovative and synergistic approaches to resolving transport issues - present and future.

TIIRIS is not a comparative assessment tool, but it exposes some difficult issues of comparability that arise from changing directions of transport policy and strategy. These include:

- identification and assessment of a sufficient range of alternatives;
- dealing with 'externalities' as integral rather than unintended by-products;
- dealing with demand impacts; and
- reconciling clarity and simplicity of exposition with technical robustness.

TIIRIS is currently under development as a working tool. However, setting out the concepts and considering how issues are being addressed is of value in its own right. The paper outlines the development of TIIRIS, including a prototype of the system, and how key issues are addressed. It draws on experience overseas and recent assessment methodology projects within Transport WA and for the Australian Greenhouse Office.

The Key Issues?

If a member of a Parliamentary Committee, having read Chapter 1 of a textbook on transport economics (the bit that says 'the demand for transport is derived demand'), asked the Minister for Transport how the hundreds of millions of dollars invested in transport each year contributed to the achievement of the objectives of the community and the Government, how would the Minister answer?

If a Minister for Transport asked the CEO of his Transport Department how the transport portfolio's investment proposals contributed to the achievement of directions and objectives established in the various regional (including Metropolitan) transport strategies, what would he say?

If a Minister for Transport asked the CEO how the Department's own investment proposals contributed to the achievement of the Strategic Directions and Objectives established in October 1998, what answer would he be able to give?

If someone asked you how your divisional proposals contributed to the same directions and objectives, how would you reply?

Even if someone asked how divisional investment proposals contributed to the objectives established in the Division's own strategies, we might have problems providing a comprehensive answer.

Background

An internationally competitive transport infrastructure is an important element in Western Australia's future economic and social development.

Western Australia's export performance impacts on all Australians. The state's exports are currently worth almost $23 billion and make up 50 per cent of the total volume of the nation's exports and 27 per cent of the total value. Put simply, the health and vigour of the Western Australian economy is largely export dependent.

There is great potential for future wealth generation in Western Australia, through mining developments, growth in tourism, diversification of agricultural products and the development of value adding industries, but this growth will be constrained if the State's transport infrastructure does not provide the level of amenity required by business**.**

Likewise, the quality of life to which Western Australians aspire and which attracts population and capital inflow will be not be realised if the infrastructure does not provide safe, accessible and cost-effective transport for both people and goods.

The Transport Infrastructure Project (TIP) was established to facilitate the development of an internationally competitive, world-class transport for infrastructure system Western Australia. The importance of world-class infrastructure lies not only in facilitating efficient movement of goods in international trade but also in ensuring that Western Australia continues to provide a high level of amenity that is attractive to increasingly footloose foreign investment.

[Note: The Transport Infrastructure Project was set up in December 1998 and has now been mainstreamed as a core activity of the Portfolio Support Group in the newly recreated Office of the Director General.]

The Project supported and complemented existing government strategies and programs aimed at achieving:

- a reduction in transport costs;
- removal of barriers to growth;
- extended transport access; and
- improvements in transport safety.

The specific aims of the Transport Infrastructure Project were to promote and support:

- a co-ordinated and integrated vision for priority transport infrastructure requirements in Western Australia including meeting the challenges of intermodalism;
- identification of gaps in transport infrastructure and inefficiencies in current systems;
- funding of key projects; and
- identification of new infrastructure opportunities and realisation of the potential worth.

The Transport Infrastructure Project aimed to achieve these aims by:

- developing and ensuring the maintenance of efficient and effective mechanisms for the coordination of decision-making on transport infrastructure among key stakeholders;
- facilitating the provision of coordinated policy advice to the Hon Minister for Transport on transport infrastructure issues;
- coordinating an integrated information base for priority transport infrastructure requirements within the framework of land use planning, regional development and other policies;
- identifying gaps in the provision of transport infrastructure, and ways in which these might be addressed;
- identifying areas where transport infrastructure is not being utilised to optimum efficiency or capacity and ways to improve its use;
- developing a transport infrastructure vision for the 21st Century, with a focus on influencing as well as responding to developments in the economic, social, environmental and technological context for transport;
- facilitating the provision and exchange of information and promoting awareness and understanding of future transport infrastructure challenges and opportunities;
- examining, identifying and promoting transport infrastructure opportunities and alternative means of funding;
- identifying strategic investment priorities;
- facilitating investment in priority infrastructure projects; and
- supporting implementation of key transport infrastructure projects important to WA.

Identification of Transport Infrastructure Opportunities

TIP has identified 'gaps' in current or planned infrastructure that might limit Western Australia's capacity to be internationally competitive. These 'gaps' include not only the need for new infrastructure and modifications to improve use but also the need to manage demand and optimise the use of existing infrastructure. Actual and potential gaps are the mirror view of opportunities that need to be grasped when appropriate.

These 'opportunities' have been identified from:

- Existing Strategic Plans, including
  - national, state or regional transport and planning strategies;
  - national, state, regional or sectoral economic development strategies; and
  - other national or state commitments and strategies (for example, on greenhouse gas emissions).
- A Review of Strategies, from the broad view of potential developments in and beyond transport, including:
  - community expectations;

- transport and industrial technology;
- economic conditions; and
- environmental awareness.

- New Opportunities, deriving from economic, social and environmental 'drivers':
  - synergies between various interests;
  - development proposals, in mining, industry, agriculture, tourism etc; and
  - national, state and local programs impacting on infrastructure.

The value of addressing transport infrastructure gaps is based on their strategic value to the State and criteria relating to:

- ***Safety*** – for users and the community;
- ***Integration*** – across transport modes, geographic regions and economic sectors;
- ***Efficiency*** – achieving results with minimum use of resources;
- ***Accessibility*** – contributing to equity of access to opportunities, goods and services between regions, demographic groups and economic sectors;
- ***Sustainability*** – maintaining or enhancing the ability of future generations to meet their needs;
- ***International competitiveness*** – enhancing export competitiveness; and
- ***Minimising risks and costs*** – for private and Government sectors.

The resulting strategic investment opportunities document (Transport, 2000) provides information on opportunities for enhancing the State's transport infrastructure. This is supported by a database of projects, at various stages of planning or readiness, to address the gaps identified.

Transport Infrastructure Opportunities for Western Australia (Transport 2000) identifies opportunities for further development of the State's transport infrastructure. These are presented within the context of a geographic, economic, social and environmental framework. They relate to projects with potential to be commenced within five years. The document:

- Identifies the importance of building on Western Australia's existing road, rail, aviation and maritime transport infrastructure;
- Demonstrates the need for further investment in transport infrastructure;
- Identifies opportunities for transport infrastructure to drive economic growth;
- Facilitates future decisions on transport infrastructure funding and investment across all modes;
- Offers opportunities to link transport infrastructure requirements and planning with other infrastructure components such as water, energy, telecommunications and security;
- Provides broad-based information that can be used to leverage funding from public and private sector sources; and
- Assists in identifying funding sources.

A Better Information Base

In the longer term, this database will be expanded into a comprehensive information system to assist decision-making on the need for, assessment of, and funding options for transport infrastructure initiatives (Arup, 2000).

The Transport Infrastructure Intelligent Relational Information System (TIIRIS), will:

- provide a State-wide view of transport infrastructure developments and proposals;
- link infrastructure developments to government policies and strategies; and
- provide for the regular and efficient updating of project information.

TIIRIS will:

- provide a core of essential information, supplemented by additional information as appropriate; and
- where possible, access information electronically, preferably directly from existing information systems.

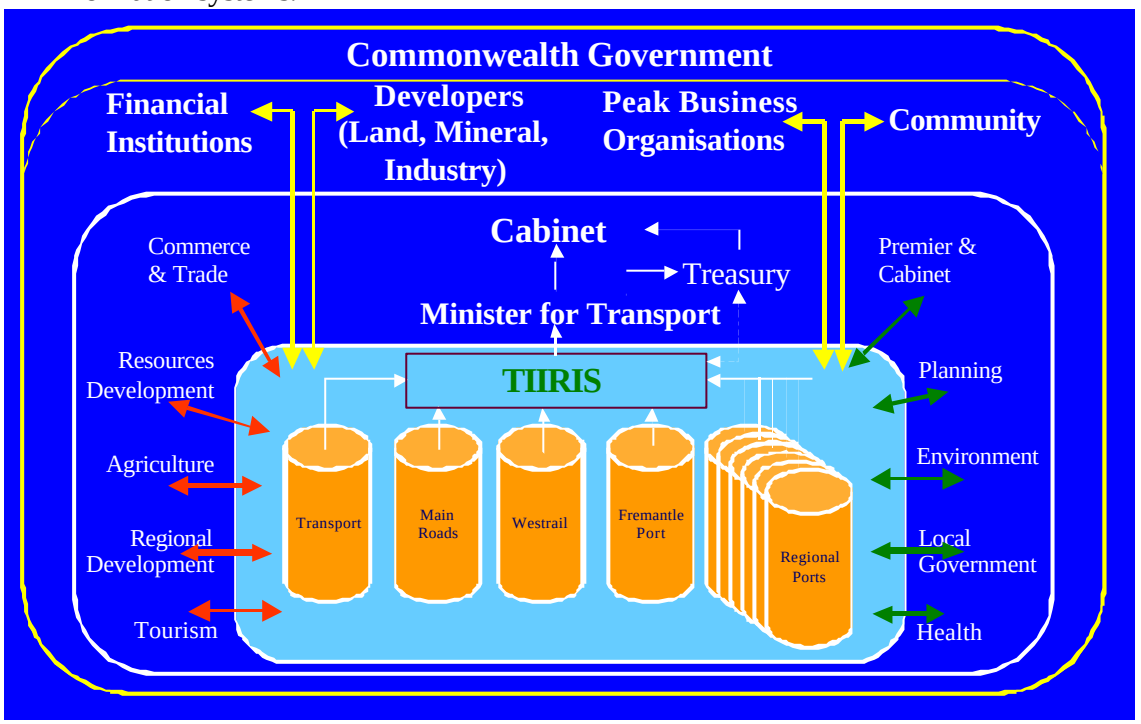

Figure 1 Stakeholder Schematic for TIIRIS

This concept recognises the fact that transport is a derived demand (and, hence, addresses the question of the hypothetical Member of Parliament noted earlier) and the interests of a wide range of non-transport and non-government stakeholders in what the transport system is able to deliver.

Subject to the constraints of government process, information in TIIRIS will be available to:

- Transport and transport agencies;
- Treasury;
- Other state government departments and agencies;

- Commonwealth government departments and agencies;
- local governments;
- private sector organisations;
- community groups; and
- individuals.

Users will be able to navigate through TIIRIS and identify and 'package' information related to their requirements, including being able to use freeform natural language enquiries, wherever possible, rather than having to work within the restrictions of 'keyword' systems that predetermine the interests of users.

A Structure For TIIRIS

The 'Core' of TIIRIS is a process for integrated decision-making on transport funding (Figure 2).

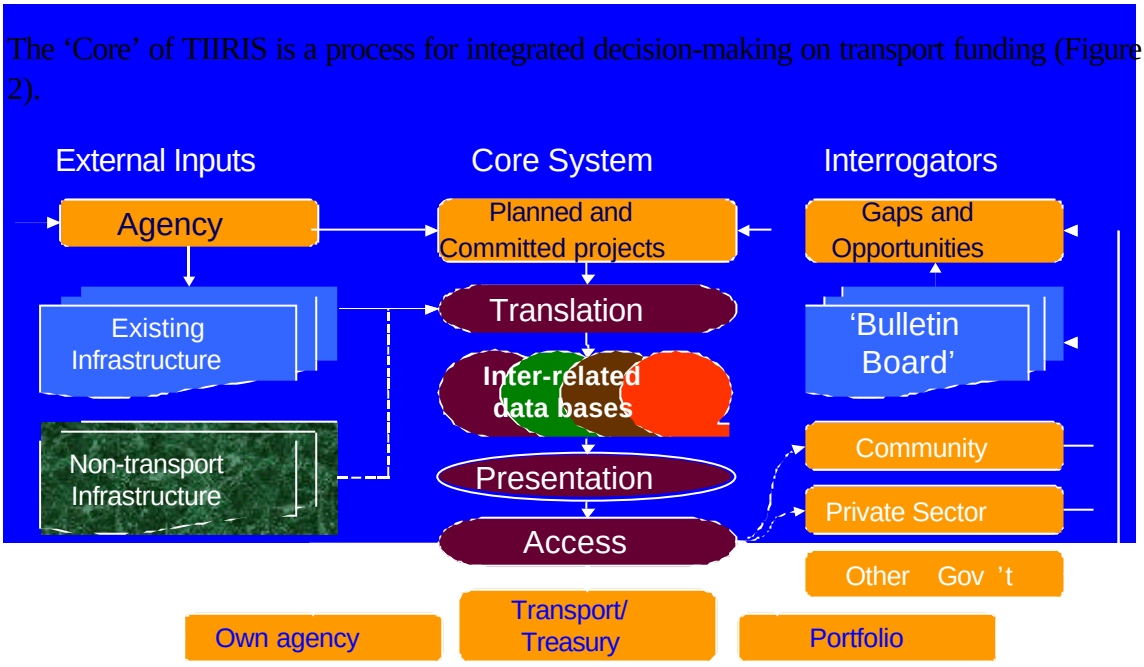

Figure 2: TIIRIS Schematic

This core functionality is straightforward, but not trivial. The technology is simply database management, but to add value it must permit better comparison of alternatives than is currently the case. To an extent, this happens simply because a number of programs are brought together in the one process (see Figure 1) and, therefore, there is potential for contestability in funding.

The bigger challenge lies in the provision of information that improves our ability to compare across disparate projects (see 'Making the Core Work', below).

Beyond the Core, TIIRIS will:

- provide information on existing transport (and, potentially, other, such as energy and water) infrastructure in ways that will be helpful to those seeking to set up business in WA, particularly those for which there are likely to be special transport requirements.

- provide access to information about infrastructure programs and opportunities (ie what is not in committed programs) to others in government, the private sector and the community. This will help:
  - identify opportunities for mutually-beneficial modification of private and public sector plans;
  - identify synergies between the plans and actions of a variety of stakeholders; and
  - create awareness of opportunities for funding from non-conventional (private and public sector) sources.
- facilitate opportunities for those outside transport agencies to contribute to the identification of infrastructure opportunities - via the 'bulletin board' or direct into the 'gaps and opportunities' stage.

Making The Core Work

The key to making the core function of TIIRIS effective, through improved decision-making is to provide a robust basis for comparison of projects that, at the same time, identifies real (rather than transport) strategic outcomes and is easily understandable. This is no trivial task, but some progress has been made with high level assessment approaches (see, for example, DETR (1998a, b)). The assessment is still best done at the project level, but with a more robust conceptual base and a common framework.

The primary reason it is often difficult to identify and compare the impacts of transport projects is that transport is a complex system, and most interventions will have a wide range of direct and indirect impacts that go well beyond the frameworks in which we currently assess projects.

The current focus of project assessment, for capital budgeting purposes, is often financial.

A secondary framework is socio-economic, or conventional benefit-cost analysis.

However, strategic directions for transport (and the more specific goals that complement them) are often not defined in ways that readily lend themselves to quantification in a benefit-cost framework. This is particularly so for new directions, where, almost by definition, the impacts of initiatives cannot be quantified through models based on past experience – there is no past experience to draw on (Ker 2001).

A common response to this is to develop a multi-criteria analysis (MCA) framework. For example, Main Roads WA has developed just such a framework for road investment assessment. However, MCA imposes two quite restrictive conditions:

- The establishment of weights to be applied to the various criteria. This has the problems that:
  - there is no reason for the same weights to apply to all projects; and
  - there is likely to be a high degree of variation in weights across the community.

  Whilst this can, to some extent, be overcome by sensitivity analysis, it is not clear how

different priorities arising from different weights can be dealt with in decision-making.

- That the criteria and their measurement be mutually exclusive - to avoid double-counting. In practice, this is rarely achievable, especially when 'externalities' also have direct financial or economic costs and a desire to avoid double-counting can lead to omission of relevant impacts.

The basic problem here is that MCA seeks to over-determine the system - prescribing too much. Application is made unnecessarily difficult and a lot of information is lost.

The alternative is to be less prescriptive about elements of the assessment process and to allow decision-makers to apply their own judgements. This is generally seen in terms of a 'Goals Achievement Matrix' (GAM) approach, which measures the progress towards a predetermined set of goals and objectives.

Reviews for Transport have recommended either MCA (Vanopoulos, 1999) or GAM (STM, 1996) approaches, but no further development has been undertaken.

Recent developments in the United Kingdom, attempting to address just this issue as part of a 'New Approach to Appraisal' (DETR, 1998a, b), have resulted in what has been termed the 'Appraisal Summary Table' (AST).

The AST has recently been trialled with a program of 68 major road schemes. An assessment of the decisions made came to the conclusion that there was a pattern relating the decisions to the information in the AST (in other words, the information did influence the decisions in a systematic way) but that there were exceptions (18 of the 68) in which other (unspecified) factors were influential or the information was used (weighted) differently by the decision-makers (Nellthorp & Mackie, 2000).

A modified version of the AST is currently being developed in Transport WA, with a more explicit focus on identifying the strategic outcomes (Figure 3). This would be supplemented by conventional benefit-cost and financial analysis.

PROJECT TITLE: Enter TitleHere			PROJECT NO. 01/xxx	
Part 1: Strategic Assessment				
STATEMENT OF PROBLEM /OBJECTIVE:	What is the Project intended to achieve?			
WHAT ARE THE KEY DRIVERS?				
Other options considered	List other options that have been or could be tested (independently or in conjunction with this one) and why they are regarded as less satisfactory than this one			
Strategies supported: Transport	Title(s) and specific reference(s) (eg Metropolitan Transport Strategy - Walking; Perth Walking - Promote safe and secure walking environments)			
STRATEGIC DIRECTION	OBJECTIVE/OUTCOME	QUALITATIVE IMPACTS	QUANTITATIVE IMPACTS	ASSESSMENT (show as scales)
Integration	Policy into practice	Non-transport strategies/objectives of Government supported: Title(s) and specific reference(s)		• Strong support • Moderate • No support
	Intermodalism	Does the project enhance integration between modes? 'Negative' only appropriate when current intermodal opportunity is downgraded or eliminated		• Yes: Strong/moderate • Not Applicable • Negative
Safety	Fatalities		Number (change): xx/year	Percent change
	Injuries		Number (change): xx/year	Percent change
Accessibility	Pedestrians and cyclists	Does the project improve conditions for cyclist and/or pedestrians?		Yes: strongly/moderately Not applicable Makes worse
	People with disabilities	Does the project improve access for people with disabilities		Yes: strongly/moderately Not applicable Makes worse
	Access to public transport	Does the project improve access to public transport?		Yes: strongly/moderately Not applicable Makes worse
	Affordability		User Costs	Percent change (present value)
Sustainability	Greenhouse		CO^2e tonnes added or removed	Percent change
	Air Quality		Photochemical smog	
	Congestion	Does the project have a beneficial impact on delays to users?		
	Regional Development	Does the project support the economic and social sustainability of regional Western Australia?		Yes: strongly/moderately Not applicable Makes worse

Figure 3. Appraisal Summary Table for WA (under development)

Key features of this approach are:

The requirement to identify alternatives considered and why they are regarded as less satisfactory than the one put forward. There are, of course, issues associated with partial overlap of projects/outcomes, but the principle is sound.

- ❖ Identification of how the project supports transport and non-transport strategies.
- ❖ Assessment within a clear framework of strategic directions and objectives/outcomes, rather than transport parameters.
- ❖ Acceptance of qualitative, as well as quantitative, assessments and ordinal scales rather than cardinal measures.
- ❖ Absence of formal weights for the various assessment criteria.

Traditional analysts might argue that this removes the 'necessary rigour' from evaluation, but traditional project analysis should, if it is being used properly, be able to supply the information required here – and a prudent analyst will always aim to be able to support whatever statements are made about projects.

Projects and Program Outcomes

The impacts of individual projects on strategic objectives and outcomes can be represented in

graphical form, creating a 'profile' of achievement for each project. Collectively, these profiles can give a picture of how a program (collection of projects) contributes to those objectives, especially with respect to the balance of achievement between them.

In principle, individual project profiles can be aggregated into a program profile (Figure 4), although the basis for such aggregation (for example, how projects would be weighted) requires further development.

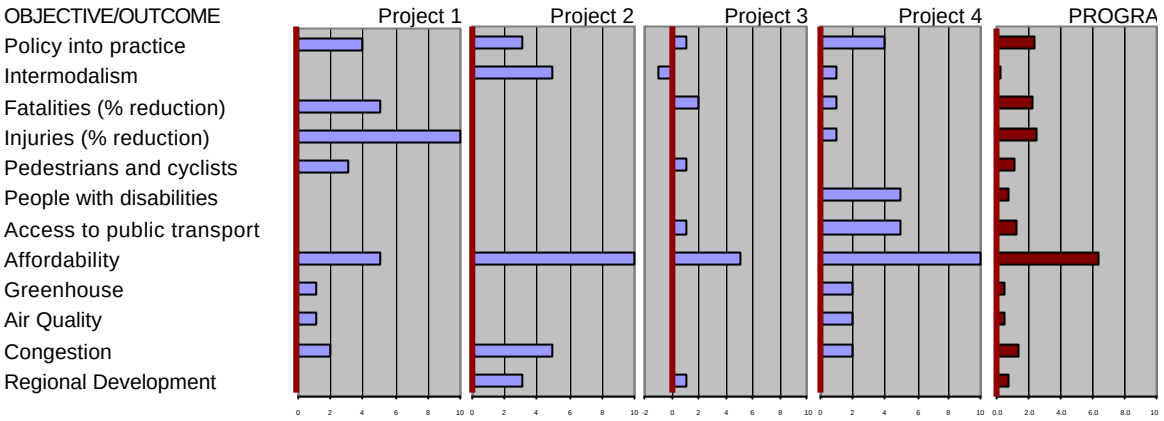

Figure 4. Strategic Outcome Profiles for Projects and Programs (illustrative)

If the overall profile does not accord with the requirements of strategic or policy directions, the projects that most contribute to this mismatch can be readily identified and modified or substituted as appropriate.

Opportunities: A Prototype For TIIRIS

The 'opportunities' component of TIIRIS is the most resource intensive, because it cannot simply draw information from other sources, but needs to interpret and make consistent information from a wide range of sources. A large amount of work has been put into this component, to provide a substantial basis for the non-core aspects of TIIRIS, but also to provide the vehicle for demonstrating some of the important aspects of the overall system.

The key to the 'opportunities' approach is the integration of high-level strategic material ('Economic & Social Overview'; 'Factors Driving Infrastructure') with information about 'Current Infrastructure' and, by deduction, 'Future Opportunities' (see Figure 5). The 'Sources' component ties the information back to (transport and non-transport) places from which the information was derived, allowing the user to verify or augment such information from other sources as he/she needs to. It is envisaged that this will include live links to information that is available on the internet.

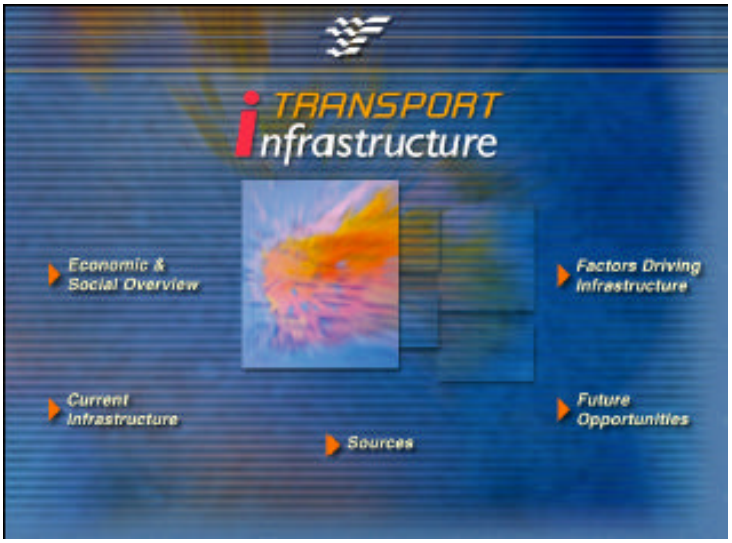

Figure 5. A Prototype Web-Based Entry into Transport Infrastructure Opportunities

The user will be able to enter the website in a number of ways, including via a region or industry, and navigate through it in a flexible way. Each 'opportunity' has a detailed data sheet that sits behind it and, for projects that have been assessed, there will be links to the 'Assessment Summary Table' (Figure 3).

A Broader Role for Integrated Assessment

The National Greenhouse Strategy (AGO, 1998) identified the need for a range of improvements in the state of knowledge in respect of best practice in transport and land use planning (Module 5.3).

Module 5.3 clearly identified the need for an integrated assessment framework for urban transport that adequately incorporates greenhouse impacts. Whilst all the projects undertaken under Module 5.3 will provide a more robust and informed basis for obtaining information on the greenhouse impacts of various initiatives and practices in transport and land use planning and development, the integrated assessment framework provides the vehicle for taking this forward into decision-making, including the link to integrated transport funding (Module 5.4).

It was recognised very early that an integrated framework must not only adequately incorporate greenhouse impacts, but also the full range of other so-called externalities. This raises a number of questions that will require further work.

It was also recognised that, whilst the focus of Module 5.3 was on urban transport, because this is where there is the greatest opportunity for alternatives to private motorised transport, the concept of integrated assessment must be extended to cover all transport and to cover 'alternatives to transport' (including land use) to truly meet the requirements.

Somewhat unexpectedly, from many people's point of view, the recommended framework

(Figure 6) did not insist on unified measurement (for example in monetary terms) or unified and weighted scales (as is usually the case in Multi-Criteria Assessment).

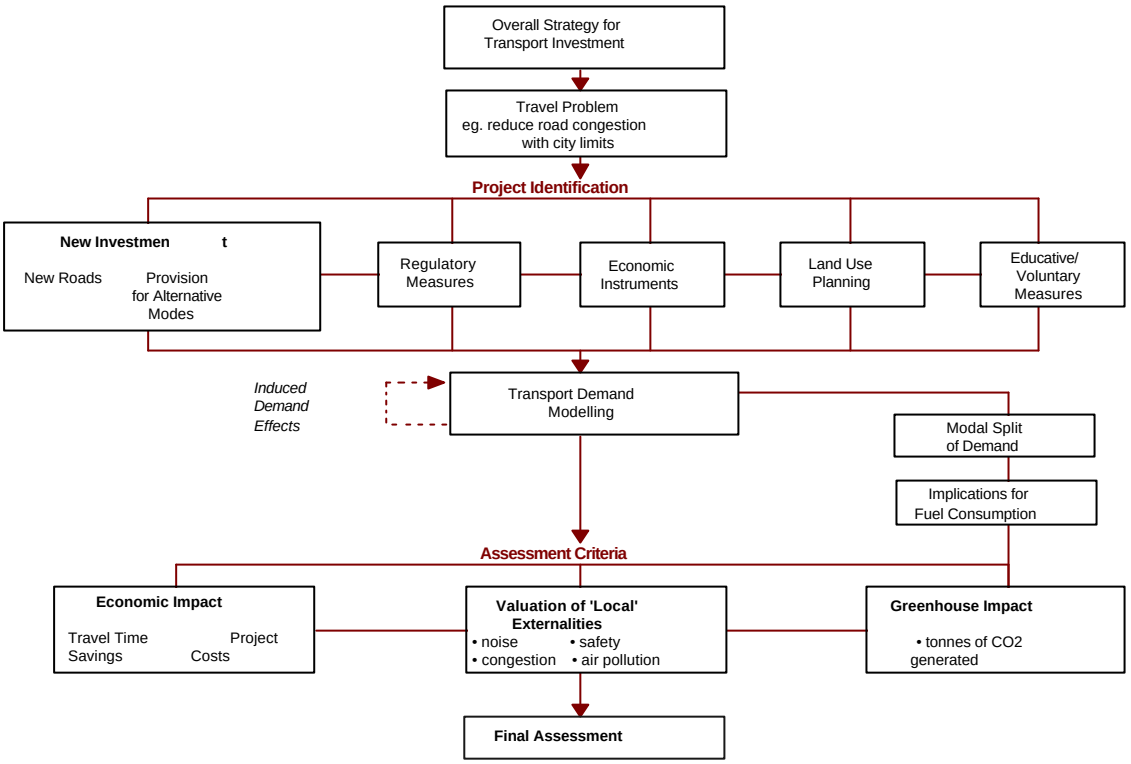

Figure 6. Suggested Integrated Assessment Framework Incorporating Greenhouse Impacts (Source: Allen, 2000)

The framework report acknowledges that: *Institutional structures are crucial to effective implementation of a consistent, integrated framework and reforms are likely to be required. A single authority in each jurisdiction responsible for all transport investment assessments would be most conducive to the adoption of an integrated assessment framework*. (Allen, 2000, p v)

Additionally: *Information sharing between jurisdictions is essential for developing best practice assessment frameworks. Frameworks and institutional structures need not necessarily be identical across States and Territories, but significant convergence is expected to occur. The States and Territories should consider the establishment of a best practice working group and commit to information sharing*. (Allen, 2000, p v)

Ultimately, integrated assessment is only of value if it affects the allocation of resources. This moves into Module 5.4 of the National Greenhouse Strategy, which the NGS denotes as being the responsibility of individual jurisdictions, but the value of convergence is likely to be at least as great as for assessment. In the case of programs with Commonwealth funding links, a shared approach to assessment and funding would be essential.

Further work is necessary to develop a suitable integrated assessment framework that incorporates greenhouse impacts. These include:

- *induced demand effects*, including the modal split of this demand and the potential of demand management tools and vehicle reduction strategies. This requires the development and refinement of variable demand models and potentially significant changes to the economic calculus of evaluation;
- *best practice methods for valuing the 'local' externalities:* although several Australian jurisdictions currently attempt to incorporate 'local' transport externalities (ie, congestion, noise, air pollution and safety) in their project evaluations, there is no consistent approach to doing so;
- *placing a credible monetary value on GHG emissions:* to compare the greenhouse externality with the other benefits and costs associated with a transport investment, it would be useful to assign a monetary value to GHG emissions. This could be based on economic instruments, such as emissions trading permits, but current estimates of the price of such permits vary widely;
- *relationship between VKT and GHG emissions, and fuel consumption and GHG emissions:* the suitability of using VKT and fuel consumption as surrogates for GHG emissions would be strengthened by better knowledge of the inter–relationships between these indicators. This, in turn, requires research in the following areas:
  - relationship between speed flow and GHG emissions;
  - likely improvements in fuel and engine efficiencies and their impact on GHG intensity of different transport modes;
  - rates of future adoption of alternative fuels by transport mode.

The Need for an Integrated Investment Strategy

To realise fully the greenhouse benefits of demand management tools and travel reduction strategies, it is necessary to adopt an integrated investment strategy. There needs to be a move away from a 'silo–based' approach to transport planning, where decisions are made on a project–by–project basis, and where investments in (and funding of) different transport modes are treated in isolation to one another. Along with the failure to recognise the role that can be played by demand management initiatives, this traditional approach does not adequately incorporate induced demand effects, nor does it take into account walking and cycling possibilities.

Instead, an integrated framework that considers a *holistic* approach to travel problems needs to be adopted. For instance, instead of appraising a single modal initiative to resolve a travel problem (eg, road congestion in a major city), a package of different projects would be identified and evaluated. This package might include a combination of expenditure on roads, and improvements in public transport and cycle path facilities. Variable demand models that take into account the induced demand effects of transport initiatives would have to be integral to any assessment.

The full range of demand management tools and travel reduction strategies (including voluntary measures) would also be assessed as part of the solution to the problem, including:

- regulatory measures;
- economic instruments;
- provision for alternative modes;
- land use planning; and
- educative and voluntary measures.

Moreover, this integrated approach could go a stage further, with transport strategies being integrated

with land use and urban planning/design. To reduce urban fringe growth, governments can implement design principles for new urban neighbourhoods and residential developments that encourage increased population density in appropriate areas, and which support a reduction in car dependence, thereby limiting GHG emissions.

There may, of course, be institutional barriers that need to be overcome in some jurisdictions before an integrated approach along the lines suggested can be implemented.

Source: Allen (2000), pp49-50

Conclusion

The effective implementation of changed directions in transport requires some far-reaching reform of planning, assessment and funding paradigms. These are so far-reaching that there is a very real danger that they will be put into the 'too-hard' basket.

Reforms are needed to many aspects of project identification, planning and assessment as well as to the ways in which investment decisions are made. This paper has discussed some recent developments that support reform in these areas.

The Transport Infrastructure Intelligent Relational Information System (TIIRIS) provides a framework for integrating the reforms that are necessary as well as providing opportunities for effective integration between government process and the broader economic, social and environmental contexts.

Any integrating framework is inherently limited by the information available to it. There are some important areas of research and development needed to improve assessment of project impacts, including issues of induced demand and the actual impacts (for example of alternative forms of transport and land use). However, some very substantial improvements can be made on the basis of current knowledge, including the outputs of projects under Module 5.3, Best Practice in Transport and Land Use Planning, of the National Greenhouse Strategy

TIIRIS is a decision-support tool, providing a means for integrating the information necessary for such improvements. A prototype demonstrating many of the features has been developed, and full development is expected to get under way early in 2001.

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