Transport investment planning

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Executive summary

New Zealand has a transport-intensive economy with a high level of GDP associated with transport relative to other developed countries. Efficiency gains in the transport sector will reduce the transport cost component of some major production activities.

Continued investment in the provision of transport infrastructure to meet increasing demand is not sustainable in economic or environmental terms. A demand management approach is advocated.

The incorporation of environmental costs into transport prices on the basis of principles such as “user pays” offer economically feasible means of improving demand management.

Increasing pressure to meet environmental targets (such as CO₂ emissions) requires the transport sector to constrain the contribution it makes to these problems.

Changes in the social environment have created pressures for a fundamental shift in the transport planning paradigm away from consensus-based models toward conflict-based models.

Transport planning development is in an “experimental” phase which is characterised by the lack of a coherent theoretical base and the lack of a consistent, comprehensive investment planning framework.

Land transport planning in New Zealand is dominated by roading-based considerations. A wider view that accommodates other modes is strongly recommended.

Land transport planning is capable of improvement through the use of clear goals, consistent criteria, modal impartiality, and inclusion of considerations of irreversibility, risk, and managerial flexibility.

Increasing attention is being paid to the interaction of land use and transportation, analysis of transport demand in terms of behavioural models, a participatory approach to decision-making, and how best to achieve distributional goals.

Demand for transport is more accurately described as demand for transport services rather than for particular “goods”.

Transport services are characterised by unique demand and supply features, public good characteristics, and externalities which create problems for private provision.

Changes in the policy framework have led to an increased emphasis on environmental effects, efficiency in resource use, and a regional focus in planning. Pressures for private provision of land transport infrastructure are expected to increase.

The investment process is still dominated by cost-benefit analysis (CBA) as the primary decision tool, despite its methodological shortcomings.
Cost-Benefit analysis as a consensus-seeking methodology is limited in its ability to meet the changing criteria and is increasingly seen as one component in a decision-making framework that incorporates other criteria.

The CBA process is capable of improvement both in terms of the methodology and the way it is applied. A number of points are discussed in relation to the Transit New Zealand evaluation procedures.

Alternative evaluation frameworks are identified and one (cost-effectiveness) is discussed as a feasible addition to the present procedures.

A case study is described in which a preliminary evaluation of alternative road options for a transport improvement proposal is compared with a rail alternative as an illustration of the use of a planning viewpoint that is not mode-specific.

Recommendations are made with regard to improvements to the current evaluation procedures and the adoption of a modified planning framework.
CHAPTER 1

Introduction

1.1 The context - transport and sustainability

Transport is an essential service for the functioning of all economies - be they industrialised economies in developed countries or the developing economies of third world nations. Much of our current wealth, based as it is on producing and consuming a continual stream of goods and services, has depended on, and spawned, a vast transportation network. Globally, transport demand growth is consistently outpacing human population growth, and by 2030 it has been forecast that vehicle numbers plying the world's roads will have doubled to one billion (Bleviss and Walzer, 1990).

Such growth poses major regional and global environmental threats. Road vehicles use about half of the world's oil production, and the emissions from burning fossil fuels are major sources of pollution. Motor vehicle emissions (carbon monoxide, nitrous oxides, hydrocarbons) at a regional level endanger human health and acidify the environment. At a global level, transport accounts for about 20% of CO₂ emissions, the major greenhouse gas contributing to the potential for global warming and climate change. Transport causes many other adverse environmental effects including noise, inner city congestion, land use conflicts, and social and psychological impacts (e.g. social dislocation and stress).

Concerns are being raised that future expansion of the transport system based on its present characteristics of land use, modal split and propulsion types, would be impossible within the Earth's ecological and resource framework - it is unsustainable (Valen Workshop, 1990). The urgent need to re-orient our transport systems towards sustainable outcomes is becoming widely recognised.

The required response has many facets. One involves emphasising more fuel efficient vehicle technologies (both within mode or inter-modal), or propulsion technologies which are 'pollution free'. Another aspect is the need to change transport planning away from being an activity based mainly on supplying transport infrastructure to meet increasing demands, towards managing or reducing these demands. For instance, in the United States, it is being realised that continuing to build transportation facilities to avoid traffic congestion is no longer a viable or realistic approach (Nicholson, 1992).

There are many policy related aspects to this change. A primary concern is to develop a more holistic policy making framework, so that environmental concerns are fully accounted for within transport and other policies (World Commission on Environment and Development, 1987).

1.2 New Zealand issues

In New Zealand, about 30% of GDP is associated with transport. This is a high proportion compared with typically 15 - 20% found in other western countries (Nicholson, op. cit.). The reasons for this include geography, demographic factors, the structure of the New Zealand economy (based as it has been, on the export overseas of comparatively bulky and transport intensive resource based commodities), the low population density (rendering public transport uneconomic), and the significance of the rural sector in the economy. There is also New Zealanders' enthusiasm for the
motor car. Car ownership rates in 1988 (507 cars per 1000 population) were the second highest in the world, and had grown at an average of 2.4% per annum since the early 1970s (Collins, 1992).

The land transport infrastructure has been developed over the last 150 years with central government playing a particularly strong role from the turn of the century onwards. Transport planning has been dominated by central and local government authorities, and investment in transport infrastructure has largely come from the public purse. The national institutions co-ordinating the planning and investment process have been formed along modal lines (i.e. differentiating between road and rail), while at the local level some inter-modal co-ordination has been evident.

Several environmental issues are now putting the transportation planning and investment process in the spotlight. The Government's signing of the Climate Change Convention at the 1992 Earth Summit commits New Zealand to work towards a stabilisation of CO₂ emissions by 2000. Transport accounts for 46% of energy related CO₂ emissions in New Zealand, and from 1985-1990 emissions from the transport sector increased by an average of two percent per annum. Curbing transport emission growth therefore is a key requirement if this country is to achieve its CO₂ target. Urban transportation issues are being viewed in new ways as authorities in the main centres of Auckland, Wellington, and Christchurch are having to reconcile increased transport demand with pressure to relieve inner city congestion and local opposition to expanding major link roads and motorways. At the same time the withdrawal of central government funding for public transport has put pressure on local and regional authorities for higher contributions.

Transport planning is affected by the Resource Management Act's requirement that local and regional authorities and other agencies promote "sustainable management of natural and physical resources.

Against this background is the rising demand for transport services. This is partly due to population growth, with the Department of Statistics projecting a population increase of 17% by 2020. Increased economic activity is another reason. For instance, the volume of wood to be removed from forest plantations to processing centres and ports is expected to double soon after the turn of the century, and treble before 2020 (Stark, 1990). Tourism is another potential high growth area with large demands for transport. The tourist industry is aiming for a target of 3 million visitors by the year 2000, a trebling of present numbers, and this would greatly increase the requirement for certain land based transport services.

The transport-intensive nature of the economy, changes to the investment funding base, environmental constraints, and an increasing demand for transport services are major considerations when making planning and investment decisions.

1.3 Objectives of the report

The major objective of this report is to describe the basis for an alternative planning framework and to propose alternative criteria for evaluating land transport investments.

One of the present difficulties is that the environmental 'externalities' of transport are not incorporated into transport planning or investment decisions in a manner that adequately expresses social preferences. Some commonly occurring environmental impacts of transportation facilities (e.g. noise, vibration, local air pollution, barrier effects) can be quantified in physical terms. There is considerable doubt, however, that the methodology used to include these in the economic calculation accords such impacts the recognition and attention they deserve.
Little progress has been made in including these factors directly into cost-benefit appraisal (Pearce and Nash, 1981). Consequently, transport modes with relatively high environmental 'costs' continue to have an unfair advantage over those with low environmental costs. For example, fuel prices do not reflect the environmental costs of fossil fuels, so the relative fuel efficiency of rail over road transport (approximately one quarter to one half the fuel intensity) is unable to be fully reflected in rail costs vis-a-vis road.

Given the large public investment in providing transport infrastructure (see Chapter 4) it is desirable that evaluations should take into account the environmental and social externalities associated with alternative options in a way which facilitates comparisons, and achieves Government's desired outcomes (at the least cost in terms of resources, including the environment).

Consequently, there is a need to ensure that criteria used in the allocation of public funds encourage provision of transport services rather than the use of particular goods to provide these services. Public funding for land transport investment should not act counter to the Government's environmental goals.

1.4 Report structure

Chapter 2 describes the planning context and the rationale for change.

Chapter 3 examines the economic issues relevant to transport service investment.

Chapter 4 describes the transport service investment context in New Zealand.

Chapter 5 provides a critical analysis of the investment process in New Zealand including the process by which prospective projects are identified and the criteria used for decision making.

Chapter 6 proposes an alternative framework with which to evaluate investment possibilities in transport services.

Chapter 7 presents a case study which illustrates the issues raised in the report.

Chapter 8 concludes the discussion.
CHAPTER 2

Transport planning - rationale for change

2.1 Transport planning

Transport planning has increasingly experienced a changing social environment characterised by uncertainty and turbulence. Healey (1977) argues that the implicit model of society that transport planners have operated with has ignored distributional issues and system inter-actions. This failure has resulted in pressure from active interest groups which has altered the structural context of planning and introduced strains and inconsistencies into the application of the planning paradigm. In Healey's view, the incorporation of social sciences into transport planning is an attempt to adjust the existing paradigm, but that in the longer term the effect is to hasten a more basic paradigm change. Healey's analysis provides a useful viewpoint from which to examine the current transport planning framework and the alternatives which have been proposed.

Healey distinguishes four broad phases of post-war development in road planning: the descriptive and prescriptive phases, the phase of rejection, and the phase of restudy. Healey's thesis has a number of insights which merit a more detailed consideration.

2.1.1 The descriptive and prescriptive phases

In the post-war period the problems of urban transport, the increasing dominance of the car as a private transport mode, and general employment considerations created the problem of anticipating traffic demand and providing the road infrastructure investment to meet the demand.

Transport planning was effectively reduced to road construction for the benefit of road users. Roads were seen primarily as physical facilities constructed to respond to the demand for transportation expressed in terms of actual and projected traffic flows. Road planning dealt largely with traffic demand, engineering feasibility, and construction, maintenance and operating costs.

The prescriptive phase is characterised by the need for urban transport models, modal split, and trip generation and origin and destination data. Cost-benefit analysis (CBA) offers an efficient accounting procedure which can bring resource allocation in the public sector into line with practices in private enterprise. Using these tools planners attempt to prepare a rational plan for an optimum transportation system for an urban area. The approach is essentially the same at project and strategic level.

Project level (i.e. local) decisions are justified on the basis of a planning framework which is removed in both time and space from the actual site of the consequences of the decision. The process assumes that a transportation system can be designed which will produce an aggregated net social benefit, usually at the regional level, conceptualised in terms such as the public interest or community welfare.

The aim of cost-benefit analysis in this phase is to guide the decision-maker into channelling resources into projects which will yield the greatest net benefit to society.
2.1.2 The phase of rejection

During the past 30 years opposition to unrestrained economic growth and a fierce concern by certain groups with quality-of-life issues has led to an increasing concern with the natural and physical environment. Dominant planning models have been rejected because they have excluded the social consequences of physical planning decisions, particularly their distributional implications. The requirement is for an analysis that goes beyond the capabilities of engineering and economics to a consideration of sociological and political questions.

This phase challenges the two main assumptions of the prescriptive phase: the consensual nature of social systems and the role this allocates to the planner, and the acceptability of the market as a mechanism to identify social priorities and distribute resources and opportunities.

This alternative perspective identifies a range of previously ignored issues such as the position of transport minorities, the implications for modal split, distribution of the costs and benefits of planning decisions, the question of compensation for negative effects of decisions, and the problems of the inter-relationships of transportation and other physical and social systems.

Healey describes the initial reaction of transport planning as an attempt to modify the dominant transport planning paradigm without fundamentally changing it, through incorporating a range of impacts of planning decisions, and using participation as both a methodology and a public relations exercise. What does not change is the basic commitment to consensus seeking models, and the dominance of the market in setting goals and evaluating alternative courses of action (ibid.).

Cost-benefit analysis is incorporated into transport planning in the descriptive and prescriptive phases as a public sector accounting procedure. Its development as a means of assessing certain socio-economic dimensions of planning decisions is a logical one. In the rejection phase, it is an attempt to introduce social welfare considerations into physical planning decisions.

Cost-benefit analysis is a consensus-seeking methodology. It is market oriented. It operates on the basis of aggregate welfare assumptions which can include a distributional perspective only with great difficulty, if at all. It is only a tool for evaluating projects generated on conventional traffic flow criteria.

The principle underlying the evaluation of alternative courses of action in resource allocation decisions is that of Pareto optimality. If one person gains and no-one correspondingly loses, there is a net gain in welfare. If some gain while others lose, however, the method can give no guidance about a correct course of action. An example of the limitations of CBA is the Kaldor-Ficks criterion that an allocation of resources is warranted if those who gain could in theory compensate those who may lose. This does not require that compensation actually occurs nor that winners and losers be identified.

Discontent with market-oriented, non-participatory decision processes, and therefore with CBA as a methodology, does not answer the problems of planning. Planners have turned to the social sciences to introduce a broader range of perspectives and variables to CBA. This has resulted in decision frameworks which include both engineering and expanded CBA evaluation criteria incorporating economic intangibles.
An alternative social impact framework

Social impact analysis shares common procedures with physical environmental impact statements. Healey describes an alternative form of social impact analysis which attempts to examine comprehensively the impacts of transport plans.

This type of social impact analysis typically identifies affected groups and describe(s) how these groups are affected. Where possible, these effects are reduced to numbers. Impact studies, however, typically pay more attention to the way benefits or effects are distributed among affected groups than to the reduction of these effects to a final number, benefit-cost ratio, or rate of return. Impact studies do ordinarily identify and array all relevant effects, even though these can seldom be added together or to user effects to provide a net amount of impact.

This kind of evaluation procedure allows highway impacts to be analysed in a series of overlapping contexts. Impacts can be seen as occurring within a temporal, spatial, political, economic and social context. They can be estimated for the project planning and construction phases for different geographical areas and for groups with differential economic and social characteristics and resources.

This form of social impact analysis considers that consensus has to be sought rather than assumed. It acknowledges implicitly that the process of seeking consensus must be a political trade-off among various interests.

In Healey's view the institutionalisation of participation, and the introduction of social sciences has both illuminated and created contradictions and tensions in planning activity, which can only be resolved by very basic changes. Current transport planning techniques have not yet adequately integrated community values, environmental quality, ecology and intangible costs and benefits into the equation for determining the allocation of resources, the programme priorities, or the location of transport corridors.

2.1.3 The phase of restudy

In this phase the transport planning process is characterised by methodologies quite different from those employed previously. Because the major issues are political, existing techniques are unsuitable for dealing with consensus seeking models, market oriented planning, and distributional questions.

Transport planning activity can be described using a series of organising contexts based on the extent and timing of transport development, participation in decision making, and equity issues. These contexts are depicted as mutually reinforcing and overlapping. An adequate approach to transport planning is seen as requiring consideration of each of them, together with their interactions.

The aim of planning is to be responsive rather than prescriptive. Planning can only be responsive, however, when it is not locked into large-scale, capital-intensive transport plans, oriented to target years far in the future. Large-scale planning requires a degree of certainty about future events which is in general unachievable in practice.

With future events and trends difficult to predict the emphasis is on a planning process which is short term and incremental. Here changes to any system can be implemented and tested against experience before further modifications are introduced.

Similarly, there is a move away from strategic and network transport planning, based on aggregate welfare assumptions and aggregate transportation data, and an increasing unwillingness to impose local costs and problems on this basis. The relationship of land use to transportation receives most
attention because of the traditional orientation of physical planners. Rather than the one way causality of previous models, the interaction of land use and transportation is of prime interest, especially as it affects the urban form and relates to social factors.

One conclusion arising from a shorter-term incremental approach is that upgrading existing road ways may be a preferred solution to constructing major new networks with uncertain consequences, long-term and for the roading system.

The use of behavioural models to predict transport demand is associated with a desire for responsive planning which is not locked into deterministic large scale plans.

Transport planners accept the plurality of interests and values which characterise society, and acknowledge that opportunities to articulate these diverse interests differ. Where the costs and benefits of changes to physical and social systems fall is difficult to predict.

The problem of participation in planning activities which have regional or national consequences is acute. At the local or project level, both information gathering and the evaluation of alternatives can be devolved to. In strategic-level or longer-term planning the solution is not so obvious.

If participation is defined as any activity which introduces additional actors, variables or perspectives into the planning process, there is little or no problem. If, however, participation is seen to involve the right not only to supply information and express a preference among alternative strategies, but also to decide which alternatives shall be adopted, the legitimacy of the decision body is problematic, especially where public funds are involved.

Relocating the decision-process in the political arena translates the technical planning analysis into a procedure for deriving and supplying information, and making recommendations on courses of action.

Equity objectives, concerned with the evenness or fairness of the distribution of the benefits and costs of transport improvements may conflict with efficiency criteria for maximising social welfare as a consequence of taking an approach that is based on fitting facilities to needs. A social approach to transport planning of the type advocated by Healey, would articulate social goals, analyse social structures and processes of change, and direct attention not simply to the user benefits or social impacts of developments such as new technologies, but to issues such as the consequences within the economic system of directing demand away from car usage. Solutions may be of a transport, non-transport, or integrated form, and may be long term, short term or incremental.

2.1.4 Summary

Attempts by planning organisations to adapt their procedures marginally to accommodate social change merely perpetuate the prevailing consensus paradigm. This results in a, "more messy and complex field of enquiry than the formal modelling or linear processes of earlier planning activities" (ibid.). The current state of transport planning in New Zealand can be considered in the context of the restudy phase described by Healey. An analysis of the socio-political context of planning is outside the scope of this report. The development of an alternative analytical framework can be seen in the context of the paradigm shift described by Healey - that is, the socio-political perspective which underlies planning procedures should be examined to determine the extent to which there is a move towards normative planning.
CHAPTER 3

Overview of transport services

3.1 Introduction

This section aims to define transport services and discuss their implications for investment planning.

This report is concerned with investment criteria for the provision of 'transport services'. Often, the term 'transport services' is confused with 'transport infrastructure'.

Transport services are demanded by the public and industry for such things as private travel, freight and business travel. Travel for people or goods is usually undertaken as part of the cost of achieving a desired activity rather than as an end in itself. Transport is regarded as being an intermediate good and demand for transport is thus an induced demand. That is, "the demand does not exist for its own sake: it is induced to satisfy some other need" (Wheatcroft In: Chartered Institute of Transport Journal, 1978). Robb (1991) suggests that mobility is the underlying basic need from transport.

Mobility can be defined as the "freedom for people (and goods) to circulate and penetrate to individual destinations and to stop on arrival" (ibid.). Therefore, in essence, transport can be seen as providing a service of mobility for people and goods. Mobility is desired for a number of reasons. It provides people with access to places of employment, recreation and other service utilities. Mobility is also essential for the movement of goods and materials for industry within the economy.

The transport infrastructure provides this transport service of mobility. For example, the Auckland Harbour Bridge is the infrastructure that facilitates mobility (service) to and from the North Shore. Transport infrastructure can take a number of forms (or modes) for land (e.g. roads, railway lines, pipelines), for water (e.g. ports, canals, waterways) and for air (e.g. airports).

These modes are not mutually exclusive but interact with one another in assisting the mobility of people and goods. The demand for transport services is not restricted to a particular mode. That is, the demand is not for road transport but rather the ability to get to places of work etc. Travellers may use more than one mode for a particular purpose e.g. travel to work may be by road and rail. Where mobility choices exist, the fulfilment of secondary needs may be the important decision criteria. Choices will be determined by factors such as:

- travel time,
- independence,
- flexibility,
- comfort,
- cost-effectiveness,
- personal attitudes to environment, health etc.

Although some literature suggests people derive utility from driving, the service is still regarded as mobility.
Given that it is not the transport infrastructure that is demanded, but rather the service that transport provides, the criteria used to allocate public funds should ensure efficient provision of transport services and not pre-determine the use of particular goods to provide these services.

3.2. Economic characteristics of transport services

3.2.1 Supply and demand

The nature of the supply of and demand for transport services makes transport service investment planning complex. Criteria used for allocating public funds to transport services must take account of this complexity.

Possibly the most important characteristic of transport is that it is not really demanded in its own right. Generally, people wish to travel so that they obtain some benefit at the final destination - the trip itself is to be as short as possible. Similarly, users of freight transport perceive it as a cost in their overall production function and seek to minimise it wherever possible.

On the supply side, certain aspects are unique also. Part of the plant is mobile and is entirely different in its characteristics to the fixed plant (e.g. rail track, airports). The fixed component is usually extremely long-lived and expensive to replace and few pieces of transport infrastructure have alternative uses. In contrast, most mobile plant is relatively short-lived and replacement usually occurs with physical obsolescence rather than technical obsolescence as with the fixed components. Mobile plant is also cheap, with the prospect of alternative employment if demand declines in one market; for example a bus can be transferred to another route or another form of service. The mobile components of transport are subject only to minimal scale economies whereas the fixed component is subject to quite substantial economies of scale. Once a rail track is laid, the marginal cost of using it falls until some maximum capacity is reached. This means that generally there is a minimum practical size below which the provision of transport infrastructure is uneconomic. There are minimum traffic flows, for example, below which it is not economic to build motorways.

These features of the fixed and mobile components of transport have influenced institutional arrangements in the sector. The high cost of provision, longevity, and scale economies associated with the fixed components create tendencies toward monopoly control, while the ease of entry, flexibility, and lack of scale effects tend to stimulate competition in the mobile sector.

Public investment in transport services is justified because of market failure due to their public good characteristics, the presence of externalities, intangible costs and benefits and equity considerations. In the absence of market failure, price signals would attract a more efficient (but not necessarily equitable) level of investment.

3.2.2 Public good characteristics

Transport services exhibit, to some degree, the defining characteristics of public goods i.e.

- Non-rivalry in consumption. Use of the service (e.g. a road or a bridge) by one person does not necessarily mean that another cannot use it.

- Non-excludability. It is (or has been) difficult to exclude people from (or charge people for) using the service. Road user charges are levied on commercial freight users but technical
difficulties in monitoring private road users have prevented charges being levied that would more fully reflect the costs of road use.

Economic theory indicates that if the provision of public goods is left to the free market, problems arise in terms of the efficiency with which goods are allocated. Unless private firms can exclude non-paying consumers (physically or legally) and unless consumption benefits can be fully appropriated by the individuals who pay for the good or service, private provision of a particular good or service will be less than is optimal from society's point of view.

For some transport services (e.g. bridges, roads), exclusion is economically feasible so a private supplier could come forward to provide the good. For example, a private firm may build a bridge and charge a crossing toll which would generate a revenue stream to cover the construction costs. The problem is that the private supplier may not provide the correct size of bridge because there is no way of determining the total demand of all individual consumers. The private supplier may not efficiently price the facility because individual consumers (users) have an incentive not to reveal their true marginal valuations (the free-rider problem).

Roading does not conform to the "textbook" definition of a pure public good. Many roads, particularly in urban areas, are characterised by congestion. Congestion increases travel time, fuel usage, and pollution and it has been argued (Michie, 1991) that even at low traffic densities, congestion can produce a marked disbenefit to road users. On congested roads, individual users who pay marginal private costs will typically not pay for the full costs of congested road use. Users generally only pay for the costs they incur, rather than the costs they inflict on society and other users. The existence of congestion implies that with roading there is rivalry in consumption. In this situation an economic case can be made for some kind of charge e.g. a road toll.

In practice, congested roads involve complex pricing problems. Assuming that the congestion occurs at regular time periods (e.g. roads at rush hours), efficient allocation requires that users be charged a price equal to the marginal costs imposed on other users during that period of the day. This implies a zero price during non-congested periods and some positive price during congested periods.

For private firms to produce non-rivalrous, excludable public goods they must pay the cost of producing them with revenues from user fees i.e. the revenue stream must cover the costs of construction and operation. To achieve the necessary revenue, firms may have to set the user fees above the marginal social costs of consumption. Thus, market failure may result because the fees exclude users who would obtain higher marginal benefits than the marginal social costs that they impose.

3.2.3 Externalities

External effects or externalities refer to the costs and external benefits generated by one person but accruing to someone else who is not a party to the activity.

Externalities can arise from production or consumption and occur when, "a variable controlled by one economic agent enters the utility function of another economic agent" (Pearce and Nash, 1981). This applies to individuals as well as firms.

Externalities can be positive (e.g. private timber forests providing scenic benefits to nature lovers) or negative (e.g. air pollution from factories damaging the health of nearby residents).
Examples of externalities common to transport include inconvenience caused to pedestrians by traffic, effects of changes in traffic flows upon business and residential properties, and interaction of roading with other transport modes.

The presence of externalities inhibits the efficient allocation of resources. For example, with a negative externality, firms will produce too much of the private good that generates the externality because the marginal costs borne by those firms do not include the negative impacts suffered by those whom the externality affects, and are therefore understated. Firms thus choose a higher level of output than they would otherwise, thus creating a net social loss and an inefficient level of production.

3.2.4 Intangible costs and benefits

Intangible costs and benefits are "those for which there is no market, and so there is no established price to act as a guide to their value" (Transit New Zealand, 1992). Examples include air pollution, noise pollution, barrier or severance effects of road and traffic streams, vibration, visual impact, historical and cultural impact, ecological impact, and psychological stress (for example, from dislocation, forced property purchase).

3.2.5 Equity

When evaluating a project, it is usually assumed in practice that the project is desirable if the benefits exceed the costs, irrespective of the persons to whom the costs or benefits accrue. The decision criterion that is used (Kaldor-Hicks) requires only that where aggregate real income increases as a result of a transport improvement, any losers could be compensated for their losses and the community would be better off. Whether the losers are actually compensated is a matter of income distribution which is a political decision. In practice, many projects are carried out without compensation being paid to those who are adversely affected.

Equity provides one justification for public involvement in transport service investment. The market mechanism is not designed to distribute services fairly. Hotchkiss (1977) maintains that the use of market prices for valuing costs and benefits provides a weighting in favour of higher income groups since their greater purchasing power leads the market to give preference to their wants. There may be a positive weighting in favour of projects desired by higher income groups which would be carried out at the cost of those on lower incomes.

One justification for ignoring income effects when considering specific projects has been that the community undertakes a number of projects whose effects are likely to be randomly distributed so that the net income redistribution effect would be small overall (ibid.). However, transport projects in inner urban areas, for example, tend to impose external costs on lower income groups while the benefits accrue to middle and upper income groups. Unless allowance is made for the income effects upon disadvantaged groups, movement towards an optimum allocation of resources is ignored.

It may be desired that more weight be given to the preferences of those who are disadvantaged in other areas of the economy. Decisions as to who should and should not benefit from these services are essentially political and should therefore be undertaken by a public authority.
3.2.6 Private provision of transport services

The classic argument against involving the private sector in the provision of road transport services is that they have strong public good characteristics. From the point of view of demand, roads are seen as non-rival in consumption and it is generally impractical to exclude additional users. Since the benefits of the roading network are available to all, consumers have no incentive to reveal their preferences and will act as free riders (Michie, 1991).

On the supply side, the “lumpy” nature of roading investment means that increasing returns to scale are likely to apply (since roads cannot be added to incrementally). This will lead to excess capacity and an optimum price of zero (ibid.). Road user charges will discourage marginal users, but since marginal users impose no substantial costs, then benefits are reduced without reducing costs. Under these conditions, private provision is unlikely to occur.

Efficient pricing under competitive conditions will result in road user charges being set below average costs during the early stages of traffic development, thus making roading investment uneconomic. If roading operators are allowed to charge monopoly prices, then a sub-optimal distribution of resources occurs i.e. individual roads are used less than they should be and demand for the transportation services provided by networks is constrained generally (OECD, 1987). In addition, private operators will be discouraged by significant entry costs and the prospect of competing with a “free” public network which enjoys a degree of monopoly protection.

However, this view is overly simplistic. The theoretical supply function indicates the provision of excess road capacity but this does not accord very well with the existence of traffic congestion. As described above (Section 3.2.2), road congestion is a negative externality which arises because transportation infrastructure is not characterised by efficient road pricing and investment. On congested roads, individual users generally only pay for the costs they bear (marginal private costs), not the costs they inflict on society and other users (social costs). Thus, private costs are lower than social costs yet demand is based on private costs only. According to Michie (ibid.), this situation can occur even when overall road user charges equal or exceed perceived marginal social costs for the network as a whole. To ensure an efficient economic outcome, a congested infrastructure will be rationed by price, at peak times, to those users who most highly value their journeys and use by travellers with less urgent demands will increase at off-peak times.

While the pricing of transport services should attempt to take into account the costs that road users impose on each other, an efficient road pricing regime is not, in Michie’s view, sufficient to ensure private sector involvement in the provision of transportation services. “The viability of a private road is largely dependent on whether prices compensate expenditure and capital charges, where efficient prices are set by the nature of the production function” (ibid.).

Technological developments in transport may be changing the nature of some transport services rendering them more a private good than a public good. For example, Hong Kong is currently investigating the bar-coding of cars, reading their motorway road usage electronically and sending owners a bill at the end of every month (OECD, 1988). Nilsson (1990) investigates voluntary private funding of so-called ‘public investments’ and concludes that under certain conditions2 private funding of public transport services can lead to welfare improvements.

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2 When the administration has insufficient resources to implement all measures that are socially beneficial and, when private beneficiaries exist who are prepared to pay.
It is possible that technological changes which allow for accurate charging of users of motorways and conditions which encourage private funding of transport services could cause a transition towards greater private investment in transport service provision.

3.2.7 Transport services and development

Transport services, are closely associated with overall economic development. Transport services provide a basic infrastructure for the economy enabling raw materials and intermediate products from varying locations to be transformed and combined through the industrial process enabling final products to be delivered to their users, and expanding the geographical extent of markets.

Transport services also contribute to the basic political and social infrastructure. Mobility facilitates the flow of people, information and ideas as well as goods, thereby assisting the political and social integration of territory. Historically, parts of the transport infrastructure have developed in response to particular needs. For example, rural road has developed to provide access to markets for agricultural commodities and inputs to primary production.

3.3 Planning issues

The appraisal of investment projects in transport infrastructure forms part of broader investment planning whose basic aim is to provide, in a convenient form, information to decide which options best meet Government's political, social and economic objectives. Three major requirements are identified as pre-requisites for rational decision making on the allocation of public funds for transport services:

- clear goals,
- consistent criteria,
- modal impartiality.

Goals

Rational investment planning in transport services can occur when those investment possibilities are chosen which best fulfil one or more goals. In order to decide on a particular investment programme it is necessary to define clearly the goal(s) of transport service investment. In the context of public investment decision-making, goals embody certain values which are held to be socially desirable (e.g. efficiency, equity, convenience, flexibility).

The goals chosen determine which positive and negative values (advantages and disadvantages of each project) are to be included in the assessment calculations. To this extent “costs and benefits have a merely instrumental character; it is only in relation to particular value conceptions (embodied in objectives) underlying the investment decisions that they become concrete factors, instead of being mere elements in an economic calculation” (Georgi, 1973, p.43).

Transport planning objectives have changed over recent years with a greater emphasis on social and environmental considerations alongside improvements in efficiency. The general objectives of policy must be specific to permit trade-offs among alternative goals at a later stage of the planning process.
Consistent criteria
The evaluation of transport projects for different modes is currently carried out using different investment criteria. For example, rail projects are evaluated using financial criteria whereas road investments are evaluated using economic criteria. The lack of consistent criteria means that projects cannot be compared on a common basis.

Investment appraisal attempts to measure the contribution of each project to the success of the defined objectives, so consequently includes and goes beyond purely financial appraisal. “The aim of a methodology for the appraisal of transport investment projects is to achieve coherence and uniformity between the different appraisals, eliminating as far as possible any criteria not linked to the general economic and social objectives or to the transport sector” (de Quiros, 1992).

Modal flexibility
Many transport service investment decisions focus on a particular mode of transport rather than the transport service itself. Such modal myopia fails to account for the fact that the transport services can be met by a variety of modes. Modal partiality may therefore result in inefficient allocation of funding. Consider the case of a forestry resource where options to transport logs to the nearest port facility include road and rail. While strategic planning recognises the need to consider both options, current investment planning procedures are mode-specific. Apparently no attempt is made to consider alternatives beyond those that relate to the existing or preferred mode.

The complexities involved in the planning of investment in transport services can, in part be attributed to three features:

- irreversibility,
- risk,
- managerial flexibility.

Irreversibility
The long technical life span of many transport projects makes an exact estimate of the benefits and costs difficult. The long life of the transport infrastructure makes a revision of investment plans once construction has begun almost impossible. Many transport investment programmes are therefore characterised by irreversibility. Pindyck (1991) suggests this has two important implications.

First, irreversible investment decisions are especially sensitive to various forms of risk such as uncertainty over the future prices, operating costs, interest rates and the cost and timing of the investment itself. Second, and more importantly, the net present value rule for investments is invalidated when investments are irreversible and decisions to invest can be postponed.

When an irreversible investment expenditure is made, the option to consider new information that might affect the desirability or timing of the expenditure is lost and disinvestment cannot occur should conditions change adversely. The value of this lost option should therefore be included as an opportunity cost of the investment. As a result, the net present value (NPV) rule - invest when the present value of the benefit stream is at least as large as the present value of the cost stream - must be modified in that the value of the benefit stream must exceed the value of the cost stream by an amount equal to the value of keeping the investment option alive. The opportunity cost of investing can be large and it is highly sensitive to uncertainty over the future value of the project (ibid.). By ignoring such uncertainty and the opportunity cost of investing, the NPV rule results in too many projects being accepted.
Risk

The discounting procedure offers a convenient vehicle by which an allowance for risk and uncertainty can be incorporated into the investment decision. Since confidence in project estimates diminishes as they come to depend on events more and more distant in time, a higher discount rate will reduce the weight given to the more distant transactions. Hence, sensitivity of the overall outcome to likely (but unknown) errors in forecasting the remote future is reduced. In the private sector, incentives to encourage investment in riskier projects are usually provided by offering higher rates of return. This analogy is sometimes used to justify the use of higher rates for riskier projects in the public sector as well. The addition of risk premia to the discount rate is of dubious validity in principle, however, and may have adverse results in practice. First, not all the estimates associated with a particular project will exhibit the pattern of "riskiness" which is implied by raising the discount rate, yet the discount rate will be applied to all aspects of the project. Second, by appearing to deal comprehensively with risk in a manner which reduces these estimates to a minor technical adjustment in the calculations, it will appear unnecessary to closely analyse of the effects of possible errors in the estimates. This will not only obscure important issues which ought to be clearly identified and investigated but will also allow analysts to assign implicitly weights to the various risks when that judgement is essentially the task of the decision makers.

Three alternative devices which can be applied to individual benefit or cost items and which reflect the particular kinds of risk which attach to them individually are expected values, sensitivity analysis, and decision theory techniques. The latter is particularly useful in situations where the problem is not so much one of making a right or wrong decision now, but rather one of making a decision now which is only a partial commitment, in the sense that it is not totally irrevocable, but which does nevertheless close certain options.

Managerial flexibility

Trigeorgis and Mason (1987) extend the debate over the short-comings of NPV analysis in showing that it cannot properly capture management's ability to revise an initial strategy if and when future events turn out differently from management's initial expectations. They propose the options-based technique of contingent claims analysis (CCA) as a means of explicitly recognising management's flexibility to adapt its future actions contingent on future events. This calls for an expanded NPV criterion that reflects two sources of a project's value - the traditional static NPV of directly measurable cash flows and a premium for managerial flexibility - that is:

Expanded NPV = static NPV + option premium

By viewing investment opportunities from the perspective of options valuation, management is in a better position to recognise that:

- conventional static NPV may undervalue projects by suppressing the option premium component,
- it may be correct to accept projects with negative NPV's if the option premium associated with the valuation of managerial flexibility exceeds the negative NPV of the project's measurable expected cash flows,
- the magnitude of under-valuation and the extent to which managers should invest more than that indicated by conventional discounted cash flow (DCF) standards, can be quantified using CCA.

These issues are relevant to investment decision making in both the major modes of land transport. The application of option valuation techniques to investments in both road and rail may help
develop an integrated framework of analysis that better permits inter-modal comparisons and improves the efficiency with which resources are allocated.

3.4 Influences of viewpoint on the process of investment appraisal

The items to be included in a project analysis depend on the person for whom it is prepared and the use to which that analysis will be put. Assuming that individuals and organisations usually operate in their own self-interest, different individuals/groups will view the economic consequences of a project differently, and may not want to have them confused with other individuals/groups.

3.4.1 Truck operators

Truck operators will prefer road development rather than rail. If a new highway is financed from general government revenues or from fuel tax the truck operators get the benefits of the new facility without a direct cost increase to themselves. Even where a new highway is to be financed by direct user tolls, truck operators may still prefer its construction if cost savings are large enough (e.g. travel time, fuel).

Taxes have little effect on the total value of a project from the social point of view because they represent only a transfer payment. They have a substantial impact on the way truck operators view a project. To the extent that changes in tax level affect total truck operating costs and truck prices, they alter the total traffic volume that will use the new facility and thereby change the total benefits that are derived from the project.

The perceptions of truck operators will also be affected by competition. If perfect competition prevails, then the same profit rate should ultimately be reached after the construction of a new highway as occurred before. If the trucking industry is characterised by strong oligopoly or monopoly, however, the same tariff may be charged after the new construction as before, so that lower operating costs will increase truck operators' profits. Thus, a project may appear more advantageous to truck operators in an oligopoly or monopoly situation. Calculations involving the point of view of truck operators should incorporate pricing mechanisms that reflect the existing competitive situation. It follows that a social welfare cost-benefit analysis of a new project may produce different results from an analysis based on the point of view of users who do not pay tolls to finance construction of the facility.

3.4.2 Rail

Similarly, rail operators will prefer construction of facilities supporting their mode while rejecting construction for other modes. For example, the corporate state-owned structure of rail in New Zealand puts them in an analogous position to a monopolistic truck operator, although rail faces strong competition from road transport for some goods.

Operating expenses and capital expenditure are met out of operating revenues. Financing of new capital developments is met either from retained earnings or from debt finance. Thus rail operators will be less eager to build a new line unless financial analysis indicates that revenues will cover both operating expenses and debt servicing for construction.
3.4.3 Distributors

The viewpoint of distributors is more difficult to characterise since their preferences for one mode of transport or another will vary. However, even where these preferences are quite strong it is unlikely that all will support a new transportation facility. Distributors who use road might still wish to have a rail facility as a means of placing a ceiling on the rates truck operators could charge and to provide an alternative means of transport in case of failure of the trucking operation. Distributors can generally be expected to favour construction of as many transportation links as possible near their base of operations. To the extent that these are publicly financed, the cost of movement is lowered so distributors are likely to press for unlimited amounts of construction since this costs them nothing (provided these links are considered as public goods).

3.4.4 Private consumers

Private individuals' preferences for different modes of transport will vary to the extent that they meet mobility needs and secondary needs. As with distributors, individuals are likely to want inter-modal competition preserved as a means of restraining prices charged by different operators. Public financing of transport facilities lowers costs so users will prefer more rather than less to the extent that they do not value external costs and congestion effects. Valuation of these implies there is some point at which marginal costs exceed marginal benefits of transport service use thus establishing a 'price' and an optimal quantity.

3.4.5 Other users

Other consumers of transport services include cyclists and pedestrians who will support provision of facilities supporting their mode of transport. Publicly financed projects that make provision for facilities such as footpaths and cycleways will impose zero costs so, again, preferences will be for more rather than less. Such facilities are often built in conjunction with roads so pedestrians and cyclists may incur costs associated with air pollution, noise, congestion etc. Their willingness to pay to reduce such costs, or willingness to accept payment for the dis-benefits should enter the social cost-benefit analysis.

3.4.6 Government

Local governments are likely to react in a similar manner to distributors in advocating the maximum possible amount of transport service provision as long as someone else pays for it (preferably central government). Central government, however, will take a broad view and will evaluate costs and benefits to all affected groups in the economy. It may also consider equity issues in deciding whose preferences should be included and what weight should be attached to costs and benefits incident to the different groups. This requires consideration of national social welfare where the objective is to minimise total costs or their present discounted values and where benefits are perceived as reductions in cost.
3.5 Summary

- Demand for transport is more properly described as an induced demand for the services that transport provides. The primary demand is for mobility rather than for a particular service.

- Transport services exhibit some of the characteristics of public goods, thus justifying provision by government. However, political, economic, and technical changes have made private provision feasible for rail and for some road facilities.

- Private provision is likely to result in over-investment due to externalities and intangible costs and benefits. Until a satisfactory means of valuing these is developed, a case remains for public investment.

- Investment criteria do not adequately account for some of the planning complexities of transport services, in particular, risk, irreversibility, and the need for managerial flexibility. Option pricing methodology should be investigated as a means of accounting for these factors.

- Demand for transport services is not necessarily restricted to particular modes, yet investment planning is mode-specific.

- Public investment planning for the provision of transport services can be enhanced through clear goals, consistent criteria, assessment of inter-actions between projects and inter-modal evaluation.

- Influences on the investment planning process include the viewpoints taken by various user groups. These often reflect preferences for one mode or another.
CHAPTER 4
Land transport investment in New Zealand

4.1 Introduction

Government has historically played a central role in land transport planning and investment in New Zealand, due mainly to the close linkage between national development objectives, and expansion of the land transport infrastructure. Railway and roading development has occurred through separate institutions, and while both have been Government owned and controlled, they have operated to different philosophies and objectives. Railway development has been driven much more by public interest, with commercial viability being outweighed by community interest considerations (Department of Statistics, 1990). Roading development has been co-ordinated by the State, but since the 1920s has been funded under a user pays philosophy.

The degree of co-ordination between the two modes has always been somewhat ill-defined. While the operating environment for the two modes has ostensibly been competitive, government regulations such as transport licensing, which were in place between the 1930s and early 1980s, ensured that the large public investment in railways was protected against competition from road transport.

Since the early 1980s, transport deregulation and more market-led thinking has seen a change in focus. The investment planning processes that now apply to road and for rail reflect differences in organisational and ownership structures, the different objectives that are sought, and the different viewpoints held.

4.2 Rail

Apart from a few private railway sidings, rail services are operated by New Zealand Rail Limited, a wholly Government owned company split off from the New Zealand Railways Corporation in October 1990. The company was set up to run the core rail business as a stand-alone commercial enterprise.

Previous investment in rail services was not subject to full commercial discipline and consequently central government picked up the tab for ongoing losses under the presumption that this represented necessary services for the 'public good'. Now, under strictly commercial objectives, New Zealand Rail no longer has to meet any external social or environmental criteria set by its owners. Each investment is now appraised using financial analysis and is expected to achieve a minimum rate of return of 15% (New Zealand Rail, 1991). New Zealand Rail has sole responsibility for determining levels of investment and investment priorities for all rail transport; rolling stock, tracks and infrastructure.

The investment pathway for rail is shown in Figure 4.1.
4.3 Road

4.3.1 The process

The investment pathway for road transport is more complex (Figure 2). The road transport infrastructure is funded partly by road users through road user fees that include fuel taxes, vehicle licensing fees and road user charges, and partly by ratepayers. Most of the road user fees are channelled through central government, which then allocates a proportion to the Land Transport Fund on an annual basis. This money can only be drawn on by Transit New Zealand. Transit NZ therefore is the main conduit for investment in roading and transport infrastructure. It has sole responsibility for investing in the state highway system, and has jurisdiction over other roading investments through the control of grants available to local authorities. Local authorities supplement their allocation from Transit NZ for roading and transport expenditure with rates-based revenue raising (Table 4.1).

Investment in vehicles is largely private investment by road users, and is dictated by private financial evaluations of the costs and benefits of using road transport. A small amount of public investment in transport vehicles is made by local authorities (public transport), supplemented by subsidies channelled through Transit NZ.
Figure 2: Investment Pathway For Road

Figure 4.2 Investment pathway for road.

Table 4.1 Public roading expenditure*

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<td>$(000)</td>
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<tr>
<td>State highways expenditure</td>
<td>222,681</td>
<td>199,389</td>
<td>268,792</td>
<td>401,382</td>
<td>259,765</td>
</tr>
<tr>
<td>Special purpose roads</td>
<td>1,328</td>
<td>1,917</td>
<td>3,056</td>
<td>2,304</td>
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<tr>
<td>Local authority roading expenditure:</td>
<td></td>
<td></td>
<td></td>
<td></td>
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<tr>
<td>From local authority funds</td>
<td>216,716</td>
<td>215,105</td>
<td>272,734</td>
<td>na</td>
<td>na</td>
</tr>
<tr>
<td>From National Roads Fund</td>
<td>187,263</td>
<td>206,165</td>
<td>242,190</td>
<td>286,410</td>
<td>180,807</td>
</tr>
<tr>
<td>TOTAL</td>
<td>627,988</td>
<td>622,576</td>
<td>786,772</td>
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* Years ended 31 March except 1990, 1991 years ended 30 June

NB. 1989-90 transition year from National Roads Board to Transit New Zealand covered 15 months 1.4.89 to 30.6.90. The National Roads Fund became the Land Transport Fund.

Source: National Roads Board, Transit NZ

23
4.3.2 Transit New Zealand Act 1989

The Transit New Zealand Act 1989 laid out the statutory procedures required for planning and funding the road transport infrastructure. The most important features were the setting up of a new authority, Transit New Zealand, and the requirements for annual land transport programmes to be produced at the territorial, regional, and national level.

**Land transport programmes**

Territorial authorities are required to submit a District Land Transport Programme (DLTP) each year to a Regional Land Transport Committee (RLTC). This programme comprises the territorial authority's recommendations concerning the land transport needs of its district. The RLTC evaluates proposals from all constituent territorial councils, amalgamates the lists, makes adjustments to proposals in the light of regional requirements and priorities, and forwards the list for approval by the Regional Council. The Regional Council considers the list of projects from the point of view of consistency with regional transport plans and funding requirements, and prepares the Regional Land Transport Programme (RLTP) for the current financial year. This is forwarded to Transit New Zealand for evaluation and incorporation into the National Land Transport Programme (NLTP).

**Transit New Zealand**

Transit New Zealand was set up by the Act to supersede the National Roads Board (NRB). Its principle objective is:

"to promote policies and allocate resources to achieve a safe and efficient land transport system that maximises national economic and social benefits" (Transit New Zealand Act, 1989)

The functions and powers of the Authority include:

- to prepare an annual NLTP,
- to manage the implementation of the following classes of outputs in the approved programme:
  - local roading
  - safety (construction and maintenance)
  - passenger transport
  - state highways
  - administration,
- to make payments from the Land Transport Account to implement the programme,
- to advise the Government in respect of the land transport system (ibid.).

Transit New Zealand prepares the NLTP based on proposals forwarded by local authorities throughout New Zealand. The NLTP determines how Transit New Zealand's budget is allocated between the various output classes. The NLTP comprises all the projects to be funded over the year through money from the Land Transport Account (either funded directly by Transit New Zealand or through subsidised local authority projects). All projects that are put up for funding from the Land Transport Account are evaluated using the procedures laid out in the Project Evaluation...
Manual (Transit New Zealand, 1991a). These procedures are a form of social benefit-cost (B-C) analysis, and weigh up project costs against the net benefits attributable to:

- savings in vehicle operating costs,
- time savings, and
- safety improvements.

Collectively, these factors account for the 'tangible' benefits of any project. The methodology is an updated version of the TR9 methodology developed by the NRB. Because the demand for funds from the Land Transport Account exceeds the supply, Transit evaluates national priorities by accumulating all projects submitted to the national programme and ranking them according to their B-C ratio. During 1991/92 no projects were funded with B-C ratios of less than 4.5 (Transit New Zealand, 1991b).

**Rationale subsidy for government**

The subsidy payable by Transit New Zealand to local authorities varies between projects, and is established by a formula derived by the NRB. This formula explicitly enables a higher level of subsidy to be payable for roading projects in rural areas. It was designed as a mechanism to provide social equity in the provision of roading infrastructure in areas that have relatively low rating bases. Even with the subsidy, roading expenditure typically accounts for 40-50% of rates expenditure for local authorities in rural areas, compared with 15-20% for urban centres.

### 4.3.3 Environmental strategy

Transit NZ has defined an environmental strategy and action plan to meet its concern for possible environmental impacts of land transport projects. "The strategy is based on the need to moderate any adverse environmental impacts while at the same time maintaining safe and efficient roads" (In Transit, April 1992). Transit NZ describes its practices to protect the environment as ensuring that all projects considered for funding:

- are consistent with an overall transportation plan,
- are consistent with the requirements of the Resource Management Act,
- highlight potential environmental impacts as part of project feasibility studies and evaluations including an evaluation of other options,
- have an environmental assessment,
- are, where necessary, redesigned, realigned or other options looked at,
- utilise good environmental engineering practices to avoid water contamination, recycle materials, make use of noise barriers, and to enhance the visual appearance of projects.

### 4.3.4 The treatment of environmental impacts

The environmental impacts of land transportation projects may be assessed in two ways. For larger scale works, environmental impact reports (EIR) are prepared following the accepted guidelines laid down by the Ministry for the Environment.

For smaller projects, procedures are laid down in the Transit New Zealand Evaluation Manual to qualitatively account for a series of 'intangible' factors that can be assessed at the discretion of the individual project analysts. These factors include noise, vibration, air pollution, severance, visual impact, ecological impact, historical and cultural impact. The intangibles may then be brought in
to the C-B framework through a process that involves a qualitative estimation of costs and benefits, and the estimation of an alternative B-C ratio; the "ranking" B-C or the "regional" B-C. Projects are thus given a new priority on the B-C list based on ranking them alongside projects deemed to be of equivalent worth. In practice, however, environmental factors are rarely evaluated under the B-C framework.

4.4 The evolving policy framework


4.4.1 The Resource Management Act

The Resource Management Act has as its purpose, promotion of the sustainable management of natural and physical resources which include land, water and air. There is a major emphasis on the effects of proposed activities rather than on the detailed process of achieving them. Transportation planning is not specifically addressed, but the interaction between land use and transportation is a critical one that has a significant effect on the environment. Transport investment planning must be capable of providing information which will allow effects to be evaluated and the environmental factors (air pollution, noise, energy use etc.) to be compared for various transportation alternatives.

Public participation in the planning process is an integral part of regional policy formation and the preparation of resource management plans. There is a specific requirement during the preparation of a proposed policy statement or plan for local authorities to consult with the Minister for the Environment, other Ministers, local authorities, the tangata whenua and anyone else who may be affected or wish to contribute.

4.4.2 Transport Directions

In mid-1991 the Government released a discussion document, Transport Directions 1991-96 (Ministry of Transport, 1991) that outlined strategic policy initiatives over the following five years. The vision for transport was outlined as an efficient transport sector based on fair competition (competing on technical and operational advantage, not cost distortions) within and between modes, with all transport sectors paying the full costs of their activities (including environmental costs). The role of central and local government was deemed to be confined to policy, planning, investigation, regulation, monitoring and audit.

Incorporating environmental concerns was outlined as one of six key strategic initiatives. Specific policy actions included:

- directing Transit NZ to give preference to transport methods producing lower CO₂ emission levels,

- producing a national policy statement on transport to guide local authority and central agency planning on environmental issues,
- developing policies to ensure that (wherever possible) the costs of environmental externalities are incorporated in the cost structures of the appropriate operating sector,
- developing policies to allow local authorities to encourage public transport to overcome urban congestion.

4.4.3 The Transport Amendment Act 1992

The Transport Amendment Act (1992) has amended some aspects of the Transit New Zealand Act (1989), in particular, the planning and co-ordination functions at a regional level. There is no longer a statutory requirement for a Regional Land Transport Committee. The main regional responsibility is now in the preparation of a Regional Land Transport Strategy (RTLS). The requirements of land transport strategies are to:

1. identify future land transport needs of the region,
2. identify the most desirable means of meeting such needs in the safest and most cost effective manner, having regard to the impact the transport system is likely to have on the environment,
3. identify the most desirable share of total demand for transport in the region to be met by each transport mode, including public passenger transport, cycling, and pedestrian traffic,
4. state the most effective means of achieving Objectives 2 and 3 above.

The strategy would have effect as a planning document for five years, although it can be amended during that time to reflect changed circumstances. Regional strategies must be prepared and completed by 1 July 1993. All district land transport programmes from 1993 onwards will be judged in terms of their compatibility with the regional strategy.

4.5 Conclusions

Transport investment planning in New Zealand is in transition. Policy initiatives over the last few years focused on reducing the direct role of central government (e.g. through deregulation and the full commercialisation of New Zealand Rail), and a continuation of this policy direction has been outlined in Transport Directions. Nevertheless, Government still retains strong control of investment funding levels through controlling the amount of money made available to the Land Transport Account.

The need for new approaches to transport planning and investment appraisal methods are now implicit through the requirements for Regional Land Transport Strategies, specified as part of the Transport Amendment Bill 1992. These strategies specifically require a transport needs and options analysis, and must be consistent with the sustainability objectives of the Resource Management Act. The statutory requirements for regional transport strategies suggest that the established parties in the land transport planning and investment process will have to move well beyond the conventionally accepted approaches for determining investment options and priorities.
CHAPTER 5

Analysis of the investment process

This chapter provides a critical analysis and discussion of the land transport investment process in New Zealand. The basic rationale is that the focus of investment decision-making should be investment in least cost transport services, rather than differentiating between various transport modes (road, rail), or concentrating only on some aspects of the transport services infrastructure. The preceding chapter concluded that the regulations governing transport in this country require this new focus.

Most of the comments made below are not new, or unacknowledged by those involved in transport investment planning. Many of the issues have been raised in discussions with staff at Transit New Zealand, New Zealand Rail and local authorities.

5.1 Objectives

The Transit New Zealand Act 1989 clearly states the principal objective of the authority in terms of a land transport system that maximises economic and social benefits. Such a system therefore must be:

- inclusive of all land transport modes i.e. road and rail as well as cycling and walking,
- concerned not only to increase the supply of transport services to meet demand, but also to manage demand in ways that lead to least cost solutions.

5.1.1 Road or rail?

Does our current system allow sensible decision-making and rational investment decisions to occur when there are choices between using road and using rail? Three examples in the forestry sector illustrate the present problems:

Road/rail issues in forestry development

The doubling in output from forestry is now making demands on the transport infrastructure in many regions. There are similarities in the general issues being addressed in each of the three examples below of the way road and rail are being evaluated.

- In 1991 the Blue Mountain Lumber Company put out a tender for the cartage of wood chips from its Conical Hill mill in South Otago through to Port Chalmers for export. This was a forerunner to the cartage of whole logs within a few years, also to be exported through Port Chalmers. The tender was won by a local trucking firm over other tenderers that included NZ Rail. Details of the tenders are confidential to the mill owners, but it is known that NZ Rail were prepared to make a substantial investment in re-laying a branch railway line to the mill (to replace one that had been earlier pulled up) and went through a resource consents process to gain approval to do this.

The potential impacts of the future transport operations are large. The trucking route runs through the centre of Dunedin, and the logging trucks would impact on Dunedin residents
through noise, pollution, traffic hazard, road maintenance costs etc. By comparison, the effect of additional rail traffic would be relatively benign. While the Dunedin City Council has expressed concern about the issue, the problem at this stage is largely outside of its jurisdiction. So far it has been an entirely private decision, but the external impacts have not been internalised into the private decision-making process.

Two other examples (from a recent article by Stott, 1992) also concern the impact of increased numbers of logging trucks, and the options that are being investigated under the Land Transport Programmes. In the Bay of Plenty, several roading bypass options are being considered to divert an increasing number of logging trucks away from Te Puke township, as they travel between the central North Island forests and Mt Maunganui. One study has indicated that today's 70,000 plus truck loads per year into Mt Maunganui are likely to increase to 170,000 by 2010. However, the five options being considered are all roading options and do not include an analysis of extending the existing railway line at Murupara into the Kaingaroa State Forest so that rail transport could become a more viable transport mode.

In Hawkes Bay, forestry traffic to the Carter Holt Harvey timber and pulp mill at Whirinaki will increase over the next decade. Most of the logs will be sourced from forests north of the mill, and this will create additional road wear, and increase the accident risk on SH2 between Wairoa and Napier. Roading options being evaluated include upgrading an alternative route that would bypass 15 km of the Wairoa-Napier highway together with construction of a bridge across the Waikare River. An alternative rail investment, involving construction of a bridge and a few hundred metres of siding into the mill was investigated by NZ Rail but has not been considered by Transit NZ.

It is unclear whether Transit NZ's statutory objective was written to deliberately include the analysis of rail options. Rail options have been considered from time to time but so far have not been evaluated on any systematic basis. There are several identifiable impediments to Transit NZ evaluating rail as part of the system:

- The Transit NZ Act 1989 confines the authority to manage outputs according to essentially five roading classes; local roading, safety, passenger transport, state highways, and administration. Thus while inclusion of rail transport is within the scope of the objective, it seems to fall outside of the output classes,

- Transit NZ has no procedures to deal with rail options. Even if rail was considered, current evaluative procedures would most likely disadvantage rail, by failing to account adequately for its relatively low environmental impact (see 4.4),

- failure to include rail options at the time of project identification (which, in part, is a consequence of the previous point).

The issue is not merely pedantic. Transit NZ's mission is potentially being seriously compromised by the failure to consider rail options. The economic costs of this omission may be significant. For instance, the marginal cost of an extra unit of freight moved by rail in many instances is very low (if it simply involves an extra wagon added to a train), whereas the marginal cost for that freight moved by road is potentially much higher (involving an extra truck journey). There is a clear need for procedures to be put in place that allow rail investment options (from the Land Transport

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3 This includes some rail passenger transport investment through the public transport subsidy.
Programme) to be evaluated on the basis of avoided cost to the road system i.e. investment in rail can be justified up to the level of total net costs avoided by transferring goods from rail to road (including tangible and intangible costs).

5.1.2 Problem definition and identification of options

There is still a clear bias in the orientation of the transport service providers towards increasing transport service supply, with little attention given to managing transport demand. The historical context from which Transit NZ evolved is relevant here. Its predecessor, the National Roads Board, was solely concerned with road construction and maintenance. As such, it was an institution largely organised around engineering priorities, and largely staffed by engineers. At the local authority level, it was roading engineers who identified and initiated most of the transport projects that were funded. Not unexpectedly, this roading orientation has continued.

Box 1 outlines the debate over the limited options considered for the State Highway 1 route north of Wellington.

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<th>BOX 1 Wellington State Highway Number One Route</th>
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| In 1990 the Parliamentary Commissioner for the Environment audited the Environmental Impact Report (EIR) for an expanded state highway route out of Wellington. The EIR compared two roading options; the widening of the existing highway between Paremoremo and Paekakariki, and a new inland highway route known as the Transmission Gully Motorway. The problem was defined by the proponents as, “the capacity of the road at peak times is inadequate and traffic volumes are expected to continue to increase”.

But as the Parliamentary Commissioner’s report noted, this narrowly focused problem definition omitted reference to the wider context, such as causes of the traffic congestion, and existing problems within communities along the route such as noise and safety (Parliamentary Commissioner for the Environment, 1990). It also narrowed the focus of solutions to those involving building more roading capacity, rather than looking broadly at ways of managing demand. The obvious alternative in the Wellington situation is greater use of public transport (e.g. through the existing rail system). There are other potential demand management options as well. For example, in Southern California employers now have a responsibility to raise the vehicle occupancy rate of their employees when travelling to and from work. The measures being adopted include car and van pooling, as well as vehicle elimination options such as public transport, telecommuting, cycling and walking. In an analysis of one year’s results, driving alone was reduced from 76% to 71%, which authorities regarded as encouraging (Nicholson, 1992).

How would the costs and benefits (including environmental and social costs) of the roading options compare with these alternatives? Obviously, unless these questions are asked, and the options fully evaluated, the answers will never be known.

In developing regional land transport strategies under the provisions of the Transport Amendment Act 1992, regional councils must address issues of both supply and demand management. The Wellington Regional Council, for example, broadened the options for transport policy in the wider
Wellington metropolitan area through exploring six policy themes, and setting up a public consultation process (Wellington Regional Council, 1992).

However, as discussed earlier, an obstacle to a reorientation of thinking is the lack of procedures with which alternative approaches can be evaluated. As one Regional Council transport planner has said ‘where is the precedent’?

There is also the question of defining objectives with respect to transport service investment. In order to decide on a particular investment programme (by means of a cost-benefit criterion) it is necessary to define clearly the goal(s) of transport service investment. Transit NZ’s mission is necessarily broad, but objectives such as “a safe and efficient ... system” need to be clarified.

Problem definition and perception of needs differs quite widely amongst local authorities. Rural perceptions are perhaps best summed up by the Mackenzie District Council Statement of Intent for 1992/93:

“Satisfying the rural sector need for permanent all weather access still remains a priority and is reflected in a bridging programme”. (Canterbury Regional Council, 1992.)

Many rural authorities are now prioritising roading projects in the expectation of increasing tourist travellers to their region.

Urban authorities identify different needs such as road building to deal with congestion, public transport etc. But many options remain poorly defined, or discriminated against. For instance, there is no clear or agreed policy between district authorities, regional councils and Transit NZ for the funding of cycleways (ibid.).

5.2 Economic analysis of projects

A major issue from the policy maker’s point of view is how to invest scarce capital resources in such a way as to best further national and/or regional objectives. Economic analysis helps identify those projects that make the greatest contribution to national income.

The process of identifying, pricing and valuing costs and benefits provides the decision maker with the information necessary to determine which projects to accept and which to reject.

Cost benefit analysis (CBA) is an instrument for introducing economic criteria into decision making and is commonly employed for assisting such analysis. There are limitations associated with CBA in terms of its philosophical basis, which the typically considered effects of transport improvements are priced and the wide range of effects that are not considered in the formal analysis. While cost-benefit analysts usually concede that non-monetary effects should form part of the analysis, in practice monetary effects usually dominate.

5.2.1 Philosophical basis of cost-benefit analysis

Cost-benefit analysis (CBA) is usually regarded as the application of the Kaldor-Hicks compensation test for Pareto improvements in welfare. The applicability of this test in circumstances in which the distribution of income is not ideal and in which compensation is not normally paid, has been widely questioned. This issue is important in the evaluation of transport improvements, since the transport
and housing patterns of different socio-economic groups are so distinct that transport improvements frequently benefit particular groups at the expense of others.

However, the compensation test is not the only way of carrying out cost-benefit analysis. There are as many different forms of CBA as there are ways of measuring and valuing costs and benefits. The Kaldor-Hicks approach seeks to value effects with respect to individuals' preferences as reflected in their "willingness to pay" for them. This approach gives a person more influence in social decisions, the higher his/her income. This is often regarded as unjust and the device of the "willingness to pay" of a consumer with the average level of income is adopted, rather than that of the individual actually affected.

The presumption that a project is socially desirable, (on efficiency grounds at least) if the gains to those made better off exceed the losses of those made less well off, implies the feasibility criterion that the willingness to pay of the gainers should exceed the sums necessary to make the losses acceptable to the losers. This criterion suggests a second measure of value i.e. the minimum compensation necessary for users to forgo the opportunity to use the service(s) provided by the project.

Most economic analyses are commonly based on the empirical assertion that the willingness to pay and willingness to accept compensation will yield equivalent measures of sacrifice. Given this presumption of equivalence, both losses and gains are usually assessed by the payment measure on the pragmatic grounds that, in general, willingness to pay is easier to estimate than required compensation. However, various writers have pointed to large differences between these alternative value measures (Knetsch J, 1990; Hanemann WM, 1991). Evidence indicates that, contrary to conventional assertions, losses are valued more than gains, the differences are pervasive and large, the disparities are not attributable to wealth effects, they are likely to persist over repeated valuations, and they are not the result of transaction costs or strategic behaviour (Knetsch, 1990).

In discussing the implications of the disparity, Knetsch (ibid.) finds that the usual practice of using the payment measure will likely lead to large understatements of the welfare changes. "As a consequence, too many environmentally disruptive projects will be encouraged, too many harmful activities will be allowed, inadequate mitigation measures will be undertaken when environmental values are at risk, and compensation for losses will not fully indemnify adverse welfare changes".

In addition, it is often desired on equity grounds to give more weight to the preferences of those who are disadvantaged in other areas of the economy. The decision as to which set of preferences is to be adopted is a value judgement that raises two major problems. There may be effects where it is considered that individuals do not know what is best for them, for example, the medical and psychological effects of noise and air pollution may be little known to the public at large. Individual revealed preferences may therefore be disregarded. Secondly, even where individual preferences are counted, the values revealed by individuals in their market transactions are not necessarily the values they themselves would wish to see used in social decision making. Thus, CBA based on individual market preferences may not be a very democratic method of advising on decision making. It is hard to reconcile its use with growing demands for public participation in transport planning.

CBA may be better seen as a way of gathering and presenting information on who is affected by transport improvements and to what extent, rather than as a decision rule in itself. The value judgements involved mean that evaluation is ultimately a political, not a technical exercise (Stanley, Nash 1977).
5.2.2 Measurement and evaluation of effects of transport improvements

Problems in the measurement and evaluation of the effects of transport improvements include those to do with user benefits, costs, externalities and intangibles, aggregating results, and internalisation.

User Benefits
The usual approach to the evaluation of user benefits regards all users, whether they are firms or households, as producers of a commodity (transport) for which they use a number of inputs. Some of these inputs (vehicles, fuel, parking space, etc.) they buy or hire on the market, while others (primarily the users' time) they supply themselves. The total cost of this bundle of inputs is known as the 'generalised' cost of a trip and it is the reduction in this generalised cost that is regarded as the benefit to the user. One difficulty arises with respect to trips that are diverted from another route or mode, or generated completely afresh, as a result of such a cost reduction. The usual approach is to value the benefits of these at one half of the figure for existing users, on the assumption of a linear demand curve.

A major practical problem is that while many different vehicle models and makes are in use, each with different capital and running costs, traffic forecasts can only be prepared for broad vehicle groups. In addition, the value placed on inputs such as users' time will vary from person to person in accordance with factors such as, time of day, length of trip, weather and comfort of the transport mode used. Research on the values placed on time spent travelling has not yet reached the stage where these factors can be adequately taken into account (Hensher, 1977).

In practice, only a very limited number of categories of such inputs (e.g. work time and leisure time) can be separately valued. For the remainder, common prices are attached to all units of the input in question. This is equivalent to assuming that all trips are homogeneous with respect to trip characteristics, tastes of the user, and vehicle user. Already, a considerable degree of approximation through averaging exists and biases may be introduced in projects which do not affect all categories of user and trip in the same proportions.

A number of issues arise in the placing of money values on vehicle capital and operating costs. First, market imperfections and externalities prevent market prices from being appropriate measures of the opportunity cost of resources used. Second, items such as motor fuel bear heavy taxation and it is standard practice to omit the tax element of market prices in calculating generalised costs on the grounds that these are transfer payments rather than net costs. Third, the capital cost of vehicles is not treated consistently. Strictly, the effect of a transport improvement on the size of the vehicle stock and frequency of replacement should be forecast and added in as a cost. In practice, part of the cost of the vehicle is treated as a running cost spread over an assumed distance run and the remainder is an overhead. The latter assumes a constant vehicle stock while the former assumes vehicle stock changes with distance run. (Stanley, Nash; 1977).

The measure of user benefit (generalised cost) is criticised (ibid.) as being partial in nature in that it looks solely at one market. Such an approach is reasonable only if price is equal to marginal social cost in all other markets affected by the improvement. Unfortunately, the transport sector is notorious for price-marginal social cost divergences. For example, without a system for charging local users for the congestion and pollution they cause, marginal social cost will typically exceed price on other roads in the area (ibid.).

The evaluation of user benefits is not straightforward. One further problem which may render others insignificant is the lack of reliable traffic forecasting. Stanley and Nash (ibid.) recommend the use of forecasts with and without the proposed transport improvement, that is, for two different
cost situations. They point out that methods of forecasting based on the projection of past trends implicitly assume that previous trends in transport costs will continue to prevail and are unable to produce a demand relationship between traffic volume and cost.

The issues to do with forecasting demand have been widely researched and discussed (Button, 1982; Hensher, 1977; Harrison, 1974). Utilisation of a demand function for forecasting purposes requires that the underlying bases of travel demand be identified, yet much research remains to be done in this area. Major weaknesses include the lack of an underlying behavioural theory and the use of aggregate rather than desegregate models (Hensher, ibid.).

**Costs**

The major part of the costs comprise the market prices of acquiring the necessary property, labour and other inputs necessary for the construction of the new facilities. It is quite possible that market prices may be inappropriate in all these cases. For instance, there may be unemployment among road construction workers, so the opportunity cost of labour is below the wage rate; the supply of road-building materials is a considerable externality-creating activity implying prices less than marginal social cost; and land may be valued at the historical cost of acquisition rather than the current market value in its next most profitable use.

It is tempting in cost-benefit studies to use market prices for those items in the analysis which have them and to use these uncritically to evaluate costs and benefits. It should be recognised, however, that market prices may be a poor indicator of social costs or benefits. Recognition of this has to be weighed against practical issues which require trade-offs to be made to establish a satisfactory working basis. This is best done by attempting to identify at least the gross deviations between market prices and social values which appear to be most significant in the particular context in which a project is to be appraised (Walsh and William, 1975).

The concept of shadow pricing is one approach to this issue but problems still remain in establishing a monetary value (Pearce and Nash, 1981). The shadow price of an input or an output is the marginal valuation imputed to that input/output which reflects its social value. In CBA, all inputs and outputs should, technically, be valued at their shadow prices. Shadow prices exist for all inputs and outputs whether traded or not. Where some combination of market mechanism and Government intervention is functioning well, the shadow price will be reflected in the current market price. However, cost-benefit analysts often regard the shadow price as a price that is imputed rather than taken directly from market transactions - either because no market exists or because the market price is considered inappropriate.

**Externalities and intangibles**

One obvious externality occurring as a result of transport improvements that is typically quantified in money terms is accident cost. (See section 3.2.3 for a definition of externalities.) Components of accident cost include "cold-blooded" costs such as loss of output due to injury or death, and "warm-blooded" costs such as pain, grief, and the intrinsic value of a human life (Stanley and Nash, 1977).

Other externalities caused by the use of transport systems include noise, air pollution, visual intrusion, and vibration. While well-established techniques exist for physical measurement and forecasting and market prices exist for some of the costs imposed on affected persons (e.g. extra spending on building repairs and cleaning due to air pollution; cost of double-glazing to reduce noise), none of this ameliorative expenditure completely remedies the harm of a degraded physical and natural environment. The costs which can be established are best regarded as lower bounds only (ibid.).
Very little progress has been made in obtaining monetary values to be placed on several important externalities of urban transport projects (e.g. fatality costs, noise and air pollution costs). The value basis of the compensating variation approach to evaluation in these (and many other) situations is extremely questionable.

Even where one believes individual preferences should be normative for social choice questions, it is not necessarily the case that the values revealed in market behaviour are the values individuals would wish to see guide social decision-taking (ibid.). The promise of a unique evaluation result if all computations are carried out in monetary terms has tended to obscure this issue. The value judgment that social choice questions should generally be decided with reference to individual preferences leads one just as naturally to a participation program to reveal such preferences as it does to market behaviour. Given the arguable basis of the compensating variation approach with regard to many urban transport project impacts, the case for participation seems particularly strong. For an explanation of the compensating variation approach, see Pearce and Nash, 1981, p. 89-95.

Participation programmes are perhaps the most promising way of deriving comprehensive data on 'ethical' preferences, to be used for guiding social choice questions. This does not mean that 'market' preference data should not be used, but it does mean that market data on particular effects would not be used if one had any reason to suspect a divergence of 'ethical' and 'subjective' preferences on particular effects. This also suggests that one would not necessarily attempt to impute monetary prices to non-market effects, measurement of these being carried out in physical units where possible or otherwise described as fully as possible (ibid.).

External effects may come about directly, as part of the process of production or consumption, or they may be indirect. They may also be tangible or intangible. CBA must take account of intangible as well as tangible items, but there is no clear-cut procedure for their correct valuation. While the design of a valuation system is the subject of a considerable amount of research in the meantime, where an item cannot be valued it must still appear in the CBA so that the decision-maker can allow for it, even though this allowance must necessarily be subjective (Hotchkiss, 1977).

**Aggregating results**

Evaluation is essentially concerned with assessing:

- qualitatively different effects on
- different groups of people over
- time.

Aggregation to produce a unique evaluation result thus involves considerations of benefits and costs on different types of effects, groups of persons and time. The cost-benefit approach to evaluation handles monetary effects, sometimes differentiates affected groups and allows for timing of effects through choice of analysis period and discounting.

Public processes provide one means of developing direct non-monetary assessments of how various groups see particular effects of projects. So long as evaluation is thought to be about individual preferences, basic evaluation data need not relate only to monetary effects. Participation processes can thus fulfil evaluative functions, both for non-monetary consequences and as between various monetary and non-monetary effects.

In using such participation for evaluative purposes in planning, the question must be asked whether such participation should be directed to achieve a unique evaluation result. Since the preferences
of different groups for project effects will generally diverge, participation may be directed solely to revealing these preferences or to reconcile them to produce a unique result (or both).

The Kaldor-Hicks approach to CBA purports to be a conflict-resolving rule for social choice decisions but if the emphasis is moved to the value judgements involved, then it cannot generally be expected that consensus will emerge from a participatory process.

Resolution between conflicting value judgements then will remain as a task for the decision-maker. Since the ultimate choice lies with the decision maker, the participation process should identify the relevant issues and the values that different groups place on these.

However, data on the views of the various groups should not become submerged in a single reported criterion. It is important that all value judgements be made clear, that the value positions of all interested groups be elaborated, and that the decision maker be in a position to make his/her own judgements on all relevant issues. There should be a process which informs the decision-maker on monetary and non-monetary consequences for various groups, and of the views of these respective groups towards such effects.

These issues are related to resource allocation and trade-offs among costs and benefits. These are basically political questions not technical ones. Only elected officials have the mandate to make such decisions. The role of the planning process is to ensure that for each alternative under consideration, all those affected by such a decision are aware of the true consequences and that the decision maker is aware of the range and magnitude of the public reaction.

Internalisation
There is no a priori presumption that a 'bad' externality should be totally removed. In some situations imposition of a tax would entirely stop the externality-creating activity. In others, it would merely change the scale of the activity. The actual outcome in either case would reflect the net value placed upon the activity. If that value was positive, the activity would continue although its scale might be changed. If the value was not positive, the activity would cease altogether.

A congested road is an example of the way in which a producer of an externality may be induced to allow for it. Every new vehicle entering the traffic stream forces added time and convenience losses onto every vehicle already in it. A congestion charge could be imposed, just equal to the value of time and convenience loss caused by the vehicle paying it. Then anyone who does not value the trip as highly as the charge, will not pay it. He or she will stay at home, travel at a different time, take a different route or travel by a different method.

5.2.3 Comprehensiveness of project evaluation
Participation processes have been suggested as a practical and ethically attractive method of generally extending the scope of evaluation considerations. Stanley and Nash (ibid.) raise a number of particular issues which deserve further attention. First, do cost-benefit studies measure all the benefits of improved accessibility? Benefits are typically ascribed only to those who actually travel but inhabitants of a city might benefit simply from the availability of transport services; i.e. the knowledge that should they wish to travel (in an emergency, or simply on the spur of the moment), their journey would be readily accomplished. This type of benefit has been labelled 'option demand', and is perhaps most significant when considering provision of a basic minimum level of service. Similarly, non-travellers may benefit from increased travel on the part of the rest of the population; the lonely, sick and aged may, for instance, receive more visitors.
One long-standing controversy on the comprehensiveness of cost-benefit analysis relates to the uncompensated losses imposed on those whose property is affected by transport improvements. Costs may be imposed on those whose property is not ultimately affected, or who have moved before work on the project commences. Such costs may or may not wholly be transfers. To a considerable extent, however, they are the result of uncertainty as to the outcome of the planning process.

Transport improvements influence patterns of location and land use. For instance, transport improvements may encourage workers to live further from their place of work in order to enjoy a higher standard of residential amenity. The resulting extra traffic will be assigned the usual benefits accruing to generated traffic. These benefits will be a proxy for the benefits of an improved residential environment, and to consider the latter separately as well would be double-counting.

Local authorities’ planning decisions greatly influence patterns of land use. In considering alternative transport plans they should, logically, at the same time consider alternative patterns of land use. Suppose such a package of transport and land use plans increases the number and/or length of car-trips to work. It is no longer clear that such extra journeys provide any benefits to those making them. The usual approach in evaluating land use plans is to treat these extra journeys as a cost, and to examine environmental improvements separately. But how can extra journeys generated by planning constraints be distinguished from those generated by transport improvements?

There has been a failure in terms of the comprehensiveness of transport project evaluation to adequately relate transport planning and land use planning. This has been associated with a tendency to look at only some of the options available. Just because a particular scheme, formulated typically to deal with a specific existing or forecast traffic problem, yields benefits over a do-nothing alternative, does not mean that it is a good scheme. There may be numerous better schemes which have never been considered and evaluated.

Cost-benefit analysis is of value, but it needs to be applied rather differently from current normal practice. It needs to be integrated into the general consideration of alternative approaches to future development of the area in question and used in examining a wide range of plans.

Emphasis should become rather less on technique and much more on the development and use of open planning processes where project evaluation becomes much more synonymous with participation in planning. The broader evaluation framework must emphasise participation and the role of cost-benefit analysis as a supplier of information to a much greater extent. The idea that project evaluation results can be meaningfully conveyed in terms of cost-benefit ratios or net present value terms by themselves serves to hide the essentially political nature of evaluation.

5.3 Limitations in Transit New Zealand’s economic evaluation of projects

In general, the economic evaluation procedures used by Transit New Zealand involve a strict accounting of costs and benefits over the life of each alternative investment option or policy and present the decision-maker with a single numeric value for each option. This allows a rapid one-dimensional set of forecasts of travel volumes, operating costs and initial capital costs, together with such data as numbers of fatal accidents and maintenance costs. Given these inputs, the determination of project life and the selection of one or more discount rates, a net present value, benefit-cost ratio, or rate of return, can be calculated. The assumptions for each alternative are varied over a range of feasible values and the sensitivity of the numeric outputs used.
Some problems inherent in the Transit New Zealand economic evaluation process include:

5.3.1 Over-simplification

By restricting the inclusion of costs and benefits to only those that are given monetary values under existing methodologies, such as time, accidents and vehicle operating costs, the 'true cost to society' will be understated. For example, additional costs associated with carbon monoxide pollution, hydrocarbon pollution, traffic noise, social disruption of neighbourhoods etc. may be measured physically, but the difficulty in determining monetary values for these precludes their being accounted for as a monetary cost. This will result in the B-C ratio being overstated and may therefore change the rank order of projects considered for funding.

The evaluation procedures do not allow for a systems analysis. This is a major shortcoming for analysing projects such as urban arterial routes that link to the urban roading network. For example, the evaluations carried out for the proposed Christchurch Northern Arterial indicate a major benefit as the reduction of high volumes of vehicles from city roads that were never designed to carry those numbers. But it has been impossible to quantify these benefits within the tangible B-C ratio accepted by Transit NZ. Network effects and inter-actions, while they may be recognised (and indeed may be quantified), are excluded from the tangible B-C ratio that is finally calculated.

The inclusion of ranking (and regional) B-C ratios has been one attempt to overcome in part these difficulties. However, an analysis of some of the projects submitted for funding shows the ranking B-C to have been calculated (or estimated) in inconsistent ways. Generally it has been used to promote projects that have a relatively low tangible B-C ratio, but which are considered to have intangible benefits (e.g. environmental quality, enhancement of the regional economy through tourism). Transit NZ has expressed dissatisfaction with the way the ranking B-C has been calculated and applied, so consequently, the tangible B-C is still the main test for determining national funding priorities (pers. comm. D Young, Transit NZ).

In the final analysis, the single value ascribed to the tangible B-C ratio is the key investment criterion. Single-value numeric estimates tend to obscure various value judgements and assumptions that must be made in order to undertake an economic evaluation. It may also blur distinctions between projects. For example, it may not be possible to distinguish between one project that saves 500 people 30 minutes of travel time per day and a project that saves 15 000 people one minute of travel time each day, although a decision-maker may be sensitive to such a distinction if he/she were aware of it.

5.3.2 The sensitivity of key variables

Given the relative simplicity of the CBA process, and the ascribing of benefit in just three ways, some of the variables used in the evaluation procedure have a key influence in determining the B-C outcome. These are discussed below:

Travel time saving

For most roading projects classified as “local roads” or “state highways”, the main benefit ascribed to investment is travel time saving. But are these presumed savings real? Transit NZ itself is concerned about extrapolating travel time savings over the life of a project (25 years in some cases). This has the effect of over-estimating the time-saving benefit from projects (pers comm. D. Young, Transit NZ). For some projects, Transit NZ considers that a first-year B-C ratio may be more appropriate.
Traffic growth effects

The over-weighting of time saving benefits is amplified if there is also an underlying assumption of an annual percentage increase in traffic growth over that period. Table A4.3 in the Transit NZ Evaluation Manual sets out forecast traffic growth rates by regions within New Zealand, and these range from zero to four percent per annum over the 25-year period. A fairly typical growth rate of two percent per annum will result in an increase in traffic density of 64% after 25 years, while growth rates of four percent per annum will see traffic density increase by 266%.

Some of these growth rates, while they may reflect current trends, give highly questionable results over the 25-year horizon. Many urban roads for instance, would simply be unable to absorb large increases in traffic density. The effect of small incremental roadway improvements that in theory will provide short term time savings, in practice may not be realised because of underlying traffic growth and the passing of traffic density 'thresholds'.

Value of life

In 1991, the Minister of Transport approved a recommendation from Transit NZ to raise the value of life used in the B-C analysis from $235,000 to $2 million. This followed an extensive 'willingness to pay' analysis undertaken by the Ministry of Transport (Miller and Guria, 1991). The revised value of life was first used in project evaluations for the 1992/93 year.

This has had a major influence on investment priorities by lifting the total benefits for projects that have a safety component, thus elevating safety-focused projects much higher up the B-C ranking list. For instance, in 1991/92 the cost of new projects approved by Transit with a B-C ratio of 4.0 or over amounted to $57.4 million. Thirty-five percent of that was accounted by 'safety' projects (where 50% or more of the benefit was due to safety factors). In 1992/93 new projects with a similar B-C criteria had risen to $81.4 million (a 42% increase), with 55% now being classified as 'safety'. The effect has been even more pronounced with projects showing greater benefits to costs. New projects in 1991/92 with a B-C ratio of 8.0 or more totalled $13.2 million, 48% attributed to safety projects, compared with 1992/93 projects which amount to $33.5 million, with 61% attributed to safety projects (pers comm. M Riley, Transit New Zealand).

This demonstrates that road transport authorities have under-invested (perhaps quite seriously) in road safety measures until now. Revising the value of life within the evaluative procedures used has resulted in a surge in investment. This may have a short term element to it (a catch-up of previously under-funded safety projects) but it will also result in safety measures being accorded a higher priority on an ongoing basis if the present relativity with other costs is maintained.

5.3.3 Information quality

All but one economic evaluation procedure requires a discount rate as input. The choice of an appropriate rate is the subject of much debate. The 10% rate recommended by Treasury and used by many analysts has been criticised in that it may not reflect either the marginal efficiency of capital (opportunity cost), or the social rate of time preference. Analysis are, of course, free to vary this in the course of undertaking sensitivity analysis. It is important to demonstrate the sensitivity of results to changes in the discount rate.

Calculation of the streams of costs and benefits over the life of alternatives requires the ability to forecast future levels of use on a year-by-year basis over the life of the alternatives. The ability to make precise forecasts for major decision variables is not highly developed. Variation in growth rates between different policies or investments introduces an element of risk, but the evaluation procedures do not currently incorporate this.
5.3.4 Time scale uncertainties

Time scale is important for investment in land transport services. Transit NZ adopts a 25 year time horizon for analysis of projects. The appropriateness of this needs to be reviewed given the change in transport planning and investment priorities. This time horizon partly reflects past traffic planning processes, where master plans, typically based on 25-year traffic projections were adopted over that time frame (Young, 1991). As Young notes, these plans are no longer appropriate; plans now need to be flexible and subject to regular review.

Nevertheless, transport investment needs to occur within the framework of a planning period longer than one year. One of the barriers to this is the uncertainty of the one-year funding round and elements of ad-hocery that have become a part of the once-per-year budget cycle. For instance, towards the end of each financial year extra investment money becomes available for additional projects, either because some local authorities have been unable to adhere to their planned timetable of roadworks, or because costs for projects undertaken in the current financial year have come in under budget. (This is particularly noticeable now because of competitive bidding.) There becomes what one transport planner has described as the end-of-year “lolly scramble”, where the B-C priority ranking may be ignored in favour of projects that will use up funding quickly before the next budgeting round.

This raises questions relating to two further issues - optimal timing of investment and the treatment of risk and uncertainty.

It has been shown above that the option to delay a project may result in a higher NPV, as can the option to invest later in a project that has been rejected currently. The use of option valuation techniques should be further investigated in addition to the use of the first-year rate of return condition to determine an optimal start time.

The first year rate of return criterion indicates whether or not to postpone an investment for one year. A project passing the test must also satisfy the NPV criterion for the whole of its life. If postponement for one year is worthwhile then the first-year rate of return criterion is re-applied for the new starting date and so on until a positive rate is found. The year in which it occurs is the optimal starting date for the project. Managerial flexibility in being able to postpone a project has economic and strategic advantages. These may be captured through a reduction in risk and uncertainty as a result of extra information that becomes available during the delay period.

5.4 Transit New Zealand and cost/benefit identification

Transit New Zealand’s CBA guidelines suggest the identification of costs and benefits included in project appraisals should be divided between those with market valuations and those that are difficult or impossible to quantify in monetary terms.
5.4.1 Costs

Monetary costs to be included in Transit New Zealand's project appraisals are “those affecting the roading authority and the funding organisation and comprise the costs, or increase in costs, of:

- project design and supervision fees,
- property required for the project,
- construction of the project, and
- maintenance of the project, both routine and special maintenance.”

(Transit NZ Manual, Vol II, 2-4.)

Non-monetary costs included in project evaluation are considered in two categories - externalities and intangibles.

Example of externalities include:

- inconvenience caused to pedestrians by traffic,
- effects of changes in traffic flows upon business and residential properties, and
- interaction of roadworks with other transport modes.


Examples of intangibles include:

- noise,
- vibration,
- air pollution,
- severance,
- visual impact,
- historical and cultural impact,
- ecological impact,
- psychological stress from forced property purchase.

The problem is how to internalise these costs.

5.4.2 Treatment of intangibles

Transit NZ (Vol II. Appendix A7) proposes three general principles in dealing with intangibles:

1. All intangible effects should be fully described in terms of who or what is affected and the scale of effect.

2. Intangible effects are to be quantified (though not necessarily in monetary terms) as far as possible.

3. Each intangible effect is to be summarised in the balance sheet; or a statement included that there are no significant intangible effects.

Two difficulties arise in the application of these principles. First, a full description of impacts of a transport project is limited by the project proposers' knowledge of which impacts are to be
considered, who (or what) is affected and the magnitude of the effect. Second, attempts to internalise these costs by adjusting the B-C ratio are essentially carried out on the basis of the assessments of project proposers.

These difficulties give rise to three sources of inconsistency in the procedure:

- Inconsistency as a result of the discretion allowed in selecting what impacts to include. This could be addressed by requiring a more explicit consideration of impacts e.g. through a checklist to ensure users indicated their assessment of the relevance of an impact. The list may not be exhaustive, but should be more comprehensive than it is now.

- Inconsistency due to the subjective nature of the weighting given to intangible costs and benefits. The lack of a guideline implicitly assigns an equal weighting to each impact yet decision makers are free to modify this without making their value judgements explicit. This could be addressed by requiring the weighting to be made explicit. It would also become easier to relate the weighting to the objectives of the project.

- Inconsistency due to the subjective nature of the decision process by which the tangible B-C ratio is adjusted to the ranked B-C to take account of the effects of intangibles and externalities. There is no formal or structured procedure for this. The use of “standard” costs for intangibles has been suggested as a means of addressing this.

The combination of the discretion in the selection of impacts, the lack of an explicit weighting scheme, and possible inconsistency in adjustments to the B-C ratio, means that project proposals may not be compared on the same basis at regional or national level. This could be addressed by a structured or semi-structured decision process which accommodated local viewpoints within a regional and national perspective (e.g. through relevance to objectives) and made the procedure more transparent by making weights attached to specific impacts more explicit.

5.4.3 Treatment of externalities

The Transit New Zealand Manual identifies externalities as costs and benefits that must be considered but does not provide clear guidelines on how this should be done. Examples are cited (p.2-2), with a warning not to include externalities which involve money transfers between individuals or groups or sectors. However, no principles are provided by which to make such a distinction. The reference is, of course, to pecuniary externalities as distinct from technical externalities. The means by which technological externalities should be identified and evaluated is not described.

When evaluating costs and benefits the manual describes the latter as ‘tangible and intangible benefits affecting the public ... and externalities’ (Transit New Zealand Manual, p.2-5). Externalities are described as ‘the reduction in costs to other than road users ... increases in external costs should be regarded as negative benefits’ (ibid.)

Under Section 3 (Specific Procedures), further clarification is given only as ‘direct benefits and dis-benefits to other than road users should be assessed and included in the appraisal. Care must be taken to avoid double counting’ (Transit New Zealand Manual, p.3-5). This is not sufficiently operational to allow users to determine which costs and/or benefits are classed as externalities or how to measure and value the technological externalities. As a consequence, users are likely to ignore the issue altogether or, in attempting to follow the guidelines given, to provide physical data or qualitative comment only. It is not clear from the manual how such information is to be incorporated into the decision-making process.

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Ideally, externalities and intangibles should be evaluated in a manner that facilitates comparisons of projects. That is, there is a need for a consistent method of evaluation to be applied to both externalities and intangibles. Currently in New Zealand transport project evaluation is not done in a way that facilitates comparison. This is largely because different transport providers (Transit New Zealand and New Zealand Rail) deal with the issue of externalities and intangible costs and benefits in different ways. While Transit notes the need to include externalities and intangibles in project evaluation, New Zealand Rail does not.

Another limitation of the current framework is that there is no mention of non-market valuation (NMV) techniques to quantify intangibles. While there are obvious limitations with NMV techniques, recent literature suggests they can be of benefit to the project appraiser. The recently re-calculated value-of-life is one example.

5.5 Summary

Key points are:

- The focus of land transport investment decision making should be investment in least cost transport services.
- The present land transport investment process, which treats road and rail options separately, offers little opportunity for a routine evaluation of an overall policy agenda and is likely to result in a serious mis-allocation of resources.
- A clear definition of the objectives and goals of transport service investment is a pre-requisite for the development of an overall land transport policy agenda.
- Cost-Benefit Analysis is a useful means of gathering and presenting information on who is affected by transport improvements and to what extent, but is unsatisfactory as a decision rule in itself.
- Adequate evaluation of user benefits is not straightforward and suffers from the lack of an underlying theory of user behaviour.
- Difficulties in establishing monetary values for important externalities and intangibles suggests that such cost estimates are more appropriately considered as lower bounds only.
- The use of individual preferences as the basis for social choice decisions is as consistent with a participatory approach to decision making as it is with a market behaviour approach.
- Participatory approaches to the evaluation of costs and benefits can be used to deal with both monetary and non-monetary effects of transport projects.
- Transport project evaluation should be expanded to fully integrate transport planning and land use planning.
- The evaluation process used by Transit NZ would benefit from more explicit guidelines on the identification and evaluation of technological externalities, explicit weighting of the intangible effects identified in the balance sheet, revision of the assumptions underlying the benefit measure, inclusion of risk analysis, and modification of the planning horizon to shorter time frames plus an allowance for the value of managerial flexibility.
CHAPTER 6

Proposed framework

6.1 Introduction

The essential elements of an alternative decision making framework include:

- making a specific and transparent linkage between policy (transport, environment and energy) and the requirements of the investment process,
- establishing a policy and investment process that is inclusive of all viewpoints,
- ensuring that a full range of options (both supply and demand) are evaluated,
- ensuring that both user and non user impacts are fully considered,
- broadening the evaluative methodologies beyond a simple CBA criterion,
- ensuring that the outcomes from the investment process are monitored and evaluated and reported back into policy making.

6.2 Linking policy with investment

One of the most important challenges is to develop coherent links between policy objectives and investment activities. It is not enough just to be 'consistent'. It is necessary to have an investment process that supports the wider policy objectives of transport, environmental and energy policy in an optimal way.

For instance it is not at all clear how CO₂ emissions should be dealt with from a land transport investment sense. In aggregate, CO₂ emissions are the product of emissions per vehicle (average emissions per kilometre travelled multiplied by total kilometres) multiplied by vehicle numbers. But given that CO₂ emissions are a characteristic of the current mainstream method of propulsion and fuel type of vehicles (internal combustion engine using fossil fuels), rather than being an inherent characteristic of a vehicle per se, it can be argued that the initial focus of concern for CO₂ emissions logically should lie with vehicle propulsion systems and efficiency improvements.

In the past the land transport public investment process has largely been constrained to focus on transport infrastructure, leaving investment in vehicles with private users. But there are recent precedents for Government directly investing in order to change propulsion methods. For instance, Government directly invested in vehicle propulsion systems through the CNG conversion kit grant scheme and the alternative fuels vehicle conversion loans scheme that were operative in the early 1980s, and administered by the Ministry of Energy. Another instance was the Government's investment through the Railways Corporation in the electrification of the North Island main trunk line.

Neither of these initiatives was tied in to the broader land transport investment programme. A future focus on transport services, however, is a challenge to broaden the scope of analysis and the range of options to which investment might flow. Investment from the land transport fund could
be used to subsidise railways, or electric vehicles for instance, if that is an efficient means of providing particular forms of transport services.

However, if this is to occur, more explicit policy objectives will need to be specified, the investment appraisal process expanded and enhanced to include a full range of environmental and other non-market effects, the nature and structure of cross-linkages between different transport modes made clear, and the question of optimal investment timing and the treatment of risk and uncertainty addressed.

6.3 Inclusion of all viewpoints

An inclusive process should be developed that enables all relevant parties and viewpoints to be represented. Simply relying on 'public consultation' will rarely be sufficient; for instance such consultation rarely allows transport disadvantaged individuals or groups to participate.

The process must ensure that district land transport programmes are linked to a Regional Land Transport Strategy (RLTS). Under the Land Transport Amendment Act 1992 there is a statutory requirement for the RLTS to include public consultation, but there is no such requirement for a District Land Transport Plan (DLTP). Thus, some form of public review process is desirable.

6.4 Supply and demand options

One of the most important needs is for the full range of transportation options to be brought to the table and evaluated. For this to occur the problem and the objective in meeting the problem should be agreed. There must be an explicit requirement to include not only 'supply side' options oriented to meet increased demand, but 'demand side' options aimed at managing or reducing demand.

Developing a broader based, inclusive process is one way of ensuring that the full range of options are brought together and evaluated. The biases in the current system, in particular the dominance of a supply side (e.g. road construction) perspective must also be addressed.

6.5 User and non-user impacts

Effective transport investment planning requires a framework for identifying, measuring and analysing impacts relating to changes in transportation facilities and operations.

Using the systems approach, impacts can be defined as the array of interactions between the transport system and all other systems (Stapher and Meyburg, 1976) including human, urban, rural, and the natural environment. An evaluation of impacts is therefore an evaluation of these interactions.

Work on transportation impacts in New Zealand has tended to focus on highway transportation. This is due largely to major transportation system improvements having concentrated on the highway mode and the relatively recent awareness of interactions between transportation and other systems (e.g. the environment). Environmental legislation such as the Resource Management Act 1991 requires detailed environmental impact assessments of major projects. It is important that the approach to identifying and measuring impacts can be used with other types of transportation systems, not just the highway mode.
Traditionally, planning has been primarily concerned with evaluating the impacts affecting users of the facility i.e. those who will travel on the proposed facility. An assessment of the consequences for non-users should also be part of the planning framework.

6.5.1 User impacts

In general, user impacts are those impacts or consequences of a transport plan that result in changes in travel times, speed, congestion and accident rates. Transit New Zealand's studies of highway benefits are generally concerned with travel times, vehicle operating costs, and accidents. User impacts are defined as running costs of the vehicle, plus travel time, plus accident likelihood multiplied by the cost of an accident. Estimates are made of the likely reduction in accidents per vehicle kilometre resulting from the proposed improvement.

User costs are evaluated primarily from impacts that can be given a monetary equivalent. They are impacts that can be identified as a result of a change of travel conditions due to a proposed change in the facility. In general, these impacts are evaluated only for the users of the facility. Reductions or increases in traffic on nearby facilities are not always included, nor is the elimination or reduction of accidents on nearby facilities calculated. For a full spectrum of consequences it is clear that these impacts should be evaluated.

6.5.2 Non-user impacts

Non-user impacts are those that affect people and the environment but do not have direct consequences for people using the facility. Impacts include social and environmental impacts such as noise, severance, air and water pollution on the people, land uses, and the environment adjacent to a transportation facility. Stopher and Meyburg (op. cit. p.102-103) list 20 factors that may be relevant to the particular location or design of a transportation project.

The evaluative process should be broadened to take account of such factors and introduce strategic considerations.

6.6 Evaluation methodologies

Wallace (1991) identified six types of decision-making frameworks which may be used to supplement each other, or as alternatives.

- Cost-Benefit Analysis
- Cost-Effectiveness Analysis
- Multi-Criteria Analysis
- Risk-Benefit Analysis
- Decision Analysis
- Environmental and Social Impact Analysis

Traditional economic evaluation procedures include only those costs and benefits that can be monetized. The use of such techniques is controversial for reasons which include the appropriateness of including consumer surplus in the analysis, the treatment of the temporal nature of transportation investment, selection of a method for calculating the trade-off between costs and benefits, and the valuation of travel-time savings, accidents and other non-monetary costs and

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benefits. In spite of these drawbacks, the simplicity of the single value makes the benefit-cost ratio more straightforward to use and communicate to non-technical people.

Cost-Effectiveness (CE) evaluation attempts to circumvent the strong quantitative orientation of the more traditional methods of economic evaluation. It allows consideration of a much broader set of consequences of transportation plans and policies and handles the evaluation of the consequences to both users and non-users.

6.6.1 Cost-effectiveness

The concept of effectiveness stems from the application of a systems analysis framework to the formulation and evaluation of alternative solutions for transportation problems. In the systems analysis framework, goals and objectives are determined initially and are used as the basis for generating alternatives. The extent to which a plan or proposal achieves the objectives is a measure of its effectiveness.

Since it is frequently the case that the alternatives generated will attain different levels of objective fulfilment, it is appropriate to assess alternatives, not only in terms of efficiency, but also in terms of effectiveness.

Cost-effectiveness analysis has been proposed (Stopher and Meyburg, 1976; Min. of Transportation and Highways, BC 1992; Faller, 1992) as a way of assessing simultaneously both the efficiency and effectiveness of a set of alternatives in a decision-oriented framework. The technique involves the use of two sets of measures to indicate efficiency and effectiveness: costs, and indicators of objectives or goal attainment. The choice among alternative projects is made on the basis of these two sets of measures, thereby eliminating the need to reduce all the attributes or consequences to a single metric.

Costs are defined in the narrow sense of total monetary outlays needed. A variety of cost models may be used but these should be related to the attainment of objectives. Costs should be modelled on a time-dependent basis and discounting procedures applied. Risk should also be incorporated through the use of subjective or objective probability distributions.

Effectiveness is defined as the characterisation of all the relevant consequences of the alternatives exclusive of costs. This requires a description of the consequences that will flow from each alternative. It is important that these are described fully so as not to obscure information or oversimplify the evaluation process or force concentration on the strictly measurable consequences of alternatives. In this regard, it is advantageous to structure consequences in a similar manner to that suggested by Stopher and Meyburg (ibid. p.142-43, See Appendix 1). Their list is not exhaustive, nor is the categorisation rigorous, but it is an advance on a purely subjective ranking scheme, and assists the analyst in making a choice as to what to include.

The choice of consequences to be taken into account is clearly of considerable importance. Feasibility and relevance are two criteria that may be used to help determine which consequences to include.

Feasibility refers to the level of detail concerning knowledge supplied about various consequences and the number of consequences to be considered. This level of complexity increases with the number of consequences and level of detail, and there comes a point where the quality of the decision is no longer increased. In addition, as complexity increases, the costs of supplying the information rise and the ease of decision-making declines. Thus, the net quality of decision-making
has an optimum in terms of level of detail and number of factors considered. Establishing such an optimum or determining the bounds of feasibility is a difficult task, but it would be advisable to bear this criterion in mind for many evaluation situations.

Relevance is determined by the relationship between a consequence and the objectives of the planning process. If a consequence is not relevant to the objectives it is irrelevant to the decision-making process. Similarly, if a consequence is identical for all alternatives or is unable to affect the selection decisions between the alternatives, it is not relevant.

The successful use of cost-effectiveness requires goals to specified and a comprehensive consideration of the type and extent of various consequences that may arise from a transportation investment.

6.6.2 Problems with cost-effectiveness

- Measures of effectiveness must be developed for all consequences of transportation projects. Some consequences such as noise, pollution and changes in property values can be measured while for others only broad statements about the direction of change can be made. It is doubtful, however, whether the procedure can provide an evaluation mechanism that is sensitive to and able to account for impacts that are not measurable.

- The method implies the need for weights for the various consequences. The decision-maker is required to assign weights to the consequences in an explicit manner rather than leaving them hidden in the evaluation process. As the number of consequences increases, the judgemental capacity of the decision-maker may be exceeded. If too much information is presented then it becomes more difficult to assimilate and integrate it in a decision process.

- The cost-effectiveness process takes no explicit account of the temporal nature of the investment. Costs and consequences are assessed at a single point in time and no account is taken of how these may vary over the life of the project.

6.6.3 Advantages of cost-effectiveness

The principal advantages of the cost-effectiveness method are its ability to take account of a full spectrum of consequences on both users and non-users, and the removal of the need to consider monetisation of non-monetary consequences. In addition, the method makes the evaluation process more transparent and consistent by inviting the decision-maker to take a major role in interpreting the information.

While the evaluation of transportation systems is still relatively poorly developed and neither benefit-cost analysis nor cost-effectiveness evaluation alone provide adequate information, it appears feasible and potentially viable to supplement the cost-benefit procedure with the cost-effectiveness procedure. The use of B-C analysis or the NPV method to consider those impacts which are readily monetised, together with cost-effectiveness analysis to consider the balance of a full range of consequences, would make a worthwhile contribution to an evaluation methodology. Both procedures could be improved to provide a better evaluation methodology.

Particular areas of improvement include:

- Improvements in the accuracy and sensitivity of the demand-forecasting process. An enhanced capability of forecasting travel is central to estimating operating cost changes, travel time changes, noise and pollution impacts etc.
- Research into the measurement and use of travel-time savings, including how to measure the value of travel-time savings; to whom they should be applied; whether it is appropriate to use personal time values in a public viewpoint evaluation, and how to forecast values of travel-time savings over the life of a transportation project.

- Improved information on what impacts are caused by various types of transportation investment, the extent of the various impacts that may occur, how favourable impacts can be maximised and unfavourable ones minimised, procedures to weight impacts to assist decision-makers in making assessments, and incorporating risk into the evaluation.

- Improvements in the use of non-market valuation techniques, particularly contingent valuation and hedonic pricing, to derive measures of value for intangible costs and benefits and for externalities.

6.7 Policy design and monitoring

The transportation investment process delivers outcomes that meet local, regional and national objectives. The planning process is intended to ensure that these objectives are consistent with government policies and that the investment procedure meets the objectives.

Governments, both local and national are accountable to ratepayers and taxpayers for the way publicly owned resources are used and managed. Policies reflect values held by society about how this should be done. Concepts such as efficiency, equity, opportunity, and political participation provide measures of value and governments are assessed on the basis of their performance in delivering value. Governments therefore, are interested not only in designing policies to achieve objectives but also in measuring whether and to what extent these policies have actually achieved what was intended.

Setting policy targets and monitoring policy outcomes therefore become important components of the policy-making process. Monitoring involves measurement so a fundamental requirement is to establish indicators that reflect states of the policy variables. These indicators may be treated separately or combined into some composite measure (e.g. an index) as a means of monitoring change. The values of the indicators over time are assessed against the target (or baseline) values thus allowing an assessment of progress toward (or away from) the desired outcome.

Policy outcomes may be classified into at least three broad categories - economic, social and environmental. When objectives are specified for each of these it becomes possible to assess transport investment proposals in terms of their support for or contribution to achieving the stated objectives.

There is currently no clear link between transport investment planning and national policy objectives. Given the major (positive and negative) contributions the land transport sector makes to the economy, social and community links and activities, and to the environment the importance of such a link becomes obvious.

An improved investment decision-making framework should provide for policy objectives that are measurable, achievable and acceptable together with target values, indicator variables and an evaluative mechanism to compare outcomes with objectives and modify the latter if necessary.
CHAPTER 7

Case Study: Proposed Te Puke bypass

7.1 Introduction

The Te Puke bypass case study highlights the emphasis placed on the provision of additional roading infrastructure to manage a growth in demand for transport services. This case study highlights the impact of limiting options too early in the strategic planning cycle. This has resulted in the investment criterion being applied to a series of similar supply side investment options based on road transport.

7.2 Background

Since the early 1970s a number of proposals to upgrade State Highway 2 in the vicinity of Te Puke township have been evaluated. The 1986 study of potential bypass routes recommended the need to identify a bypass route east of Te Puke with the objective of relieving anticipated traffic congestion in the town.

The 1988 Tauranga to Paengaroa State Highway Strategy Study identified highway realignments north and south of Te Puke to be economically viable. A 1989 Bay of Plenty Regional Council Transportation Study confirmed highway upgrading including a Te Puke Bypass was needed within 10 years to cater mainly for increased timber cartage to the Port of Tauranga.

In 1990 Transit New Zealand extended the scope of the Te Puke bypass investigation in order to evaluate more direct routes further to the east. In total, four bypass routes and a further internal bypass route were appraised.

Early in 1992 a scoping study was commissioned by Transit. It aimed to:

- define practical alternatives for State Highway 2 in the Te Puke area and to identify the likely planning and environmental issues associated with a bypass,

- define those bypass options which will provide an economic alternative to the existing State Highway 2 route,

- recommend feasible roading options for full engineering scheme assessment and environmental impact assessment,

- provide further public information on options for a bypass of Te Puke.

The extent of the report was to prepare up to a first stage of an Environmental Impact Assessment.

The highway problems to be addressed were taken from the State Highway 2, Tauranga to Paengaroa Strategy Plan, September 1988. Three problems areas were identified: Te Puke township; north of Te Puke; and south of Te Puke.
The Te Puke township problems were identified as being:

- The large number of Heavy Commercial Vehicles (HCV) comprising mainly logging trucks and large truck and trailer units. Some 12 percent of total traffic entering Te Puke comprised HCV's (an estimated 1,000 HCV's per day). This category of traffic volume is expected to grow rapidly with an additional 500 vehicles per day over the next 10 years.

- Vehicle speeds at points of entry, particularly from the south.

- With high traffic volumes (15,000 vehicles per day) in the main street, the large number of heavy vehicles generates conflict with Commercial Business District (CBD) activities.

- A high accident rate with the rate of serious and fatal accidents being well above the national average. The accident rate is presently being addressed by a number of remedial works.

North of Te Puke problems were:

- Congestion (10,000 vehicles per day).

- A high accident rate (23 accidents per 10^8 vehicle kilometres).

South of Te Puke problems were:

- Congestion (8,000 vehicles per day).

- An even higher accident rate (30 accidents per 10^8 vehicle kilometres).

The problem was summarised as being the conflict between through traffic and local traffic. A large proportion of the through traffic doesn't stop and could therefore by-pass the town. The highway both north and south of Te Puke is also reaching its capacity and is inadequate as a long term arterial route.

The strategic options and the objectives for each strategy are presented in a report by Transit NZ (1992)\(^4\) p.6. The analysis of these options covers technical, economic, community and environmental factors and is useful in the context of the approach that is proposed in this report. The evaluation summaries are a form of the analysis promoted in this report.

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With respect to the economic evaluation the findings are presented below.

Table 7.1 Basic benefit/cost ratio (preliminary)

<table>
<thead>
<tr>
<th>Option</th>
<th>Cost $m</th>
<th>B/C</th>
<th>Comment</th>
</tr>
</thead>
<tbody>
<tr>
<td>Base Option</td>
<td>1.56</td>
<td>-</td>
<td>Do-minimum plus intersection improvements at Year 10</td>
</tr>
<tr>
<td>1</td>
<td>11.0</td>
<td>≤1.0</td>
<td></td>
</tr>
<tr>
<td>2</td>
<td>14.5</td>
<td>≤2.0</td>
<td></td>
</tr>
<tr>
<td>3</td>
<td>17.5</td>
<td>2.0 - 3.0</td>
<td>Preliminary analysis not sufficiently detailed to define B/Cs more precisely. Indications are that B/C of Option 3A is slightly higher than for 4A</td>
</tr>
<tr>
<td>3A</td>
<td>17.7</td>
<td>2.0 - 3.0</td>
<td></td>
</tr>
<tr>
<td>4</td>
<td>21.2</td>
<td>≤1.0</td>
<td></td>
</tr>
<tr>
<td>4A</td>
<td>21.4</td>
<td>2.0 - 3.0</td>
<td></td>
</tr>
<tr>
<td>4B</td>
<td>25.0</td>
<td>2.0 - 3.0</td>
<td></td>
</tr>
<tr>
<td>5</td>
<td>10.0</td>
<td>≤1.0</td>
<td></td>
</tr>
</tbody>
</table>

The alternatives for the bypass are:

- Base option: Upgrade existing State Highway.
- Option 1: External bypass - Manoeka Road to Strang Road.
- Option 2: External bypass - Kopuroa Canal to Strang Road.
- Option 3: External bypass - Kopuroa Canal to Rangium Rail Overbridge.
- Option 3A: Option 3 with deviation to avoid crossing land of importance to Maori.
- Option 4: Domain Road to SHW 2/23 junction via Papamoa East.
- Option 4A: Option 4 using alternative deviation through Te Tumu Road.
- Option 4B: Option 4 using deviation to avoid Te Tumu Road.
- Option 5: Internal bypass - Ohineangaanga Stream Bridge to Strang Road.
Table 7.2 Comparative benefit/cost ratio (preliminary) of recommended options (assuming capacity improvements on existing routes).

<table>
<thead>
<tr>
<th>Option</th>
<th>Cost $m</th>
<th>B/C</th>
<th>Comment</th>
</tr>
</thead>
<tbody>
<tr>
<td>Base Option with passing lane</td>
<td>2.1</td>
<td>-</td>
<td>Do-min plus intersections at Year 10 plus passing lanes Year 1 and 3</td>
</tr>
<tr>
<td>3 + extension</td>
<td>27.0</td>
<td>2.0 - 3.0</td>
<td>Extension with passing lanes Year 5</td>
</tr>
<tr>
<td>3A + extension</td>
<td>27.2</td>
<td>2.0 - 3.0</td>
<td>Extension with passing lanes year 5</td>
</tr>
<tr>
<td>4A</td>
<td>21.4</td>
<td>2.0 - 3.0</td>
<td>Preliminary analysis not sufficiently detailed to define B/Cs more precisely. Indications are that B/C for Option 3A is higher than for 4A</td>
</tr>
<tr>
<td>4B</td>
<td>25.01</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Table 7.1 provides the benefit/cost ratios from an incremental analysis relative to the do-nothing option.

Table 7.2 provides an analysis of each option independently. This has required a standardisation of route length and quality and has been used to identify “best” options to be evaluated more fully.

The economic evaluation suggests that options 1, 4 and 5 are uneconomic (B/C < 1) while the remaining options have reported B/C ratios of between 2 and 3.

Currently options 3, 3A, 4A and 4B are being fully evaluated by Transit although the analysis is not yet available.

7.3 An alternative perspective

To date the options considered have been based on diverting existing traffic flows onto improved highway infrastructure that will offer savings in time, operating costs, and accident costs.

In effect there is a range of roading infrastructure options to cope with forecast traffic volumes. As each option has slightly differing objectives (p. 6 Scoping report) it is difficult to identify the impact desired.

Given that the objective is to reduce the level of HCVs passing through Te Puke, there are options other than those proposed in the scoping report. One such option would be to encourage the use of rail for the movement of logs from the Rotorua-Taupo region to the Port of Tauranga.

Under this option the existing and future logging truck traffic (see below) would be removed from the roading system. This would reduce traffic volumes by an estimated 10 percent on present levels and reduce the rate of future growth in traffic volumes.
The appeal of such an option would be to remove the HCV traffic volume from the entire road system from say Rotorua to Tauranga. If additional adjustments are required, these could be achieved by options which differ significantly to the existing proposals.

The analysis of an option that includes rail requires data which is not readily available. For example, some commentators suggest extending the Murupara line to Taupo, the capital cost of which is not available even as an “estimate”. Others suggest trucking to existing rail heads.

The following analysis attempts to evaluate the use of rail from existing rail heads to move logs to the Port of Tauranga. A number of assumptions are involved which are made explicit. The purpose is to ascertain if gains in economic efficiency are possible through the use of rail over and above the options presently considered.

It is suggested that Transit's investment could be in one (or both) of two forms. The first is to invest in NZ Rail thereby reducing the cost of the service in order to achieve the substitution from road transport and/or to invest in technology that imposes the true cost of road usage back onto logging and other HCV transport. Either option would have the impact of changing the relative pricing of rail and road options. This case study investigates the potential of investing in NZ Rail to provide the service.

In discussion with NZ Rail it was identified that there was no need for additional capital investment into new tracks or upgrading existing railway tracks. Existing infrastructure would cope with the load requirements. Rolling stock with sufficient capacity is also presently available.

The cost of providing such a service is considered by NZ Rail to be extremely commercially sensitive and as a consequence was not made available to this study. Proxy values are identified later but the accuracy of these is largely unknown.

The economic evaluation model is based on the Transit evaluation framework to enable comparison between the Transit options and the alternate rail option.

As such the benefits identified are:

- reduced maintenance cost of existing highway,
- reduced operating cost of logging trucks,
- the value of time saved by HCV vehicles,
- reduced accidents through lower traffic volumes,
- reduced environmental impacts from road usage (not quantified),
- time savings of other road users (not quantified).

The costs identified are:

- ongoing maintenance to road,
- rail operating costs,
- rail environmental costs (not quantified).

The lack of actual rail operating costs is not a major drawback as this figure can be entered over a range of values that move the B/C ratio to the equivalent road B/C.
The lack of any data on the rate of substitution between modes has led to the assumption that a full substitution of logging trucks would be achieved. In reality, this is unlikely, but it is also foreseeable that a proportion of existing road freight may be substituted onto rail.

7.4 Benefit calculations/assumptions

Traffic volume
For the purposes of this exercise a route length of 70 kilometres is used. Note that this is the road route length from which benefits will be derived. It is assumed that there are presently 500 HCV vehicles/day of which 450 are assumed to be logging trucks. The growth in logging truck volume is estimated to be an additional 500 vehicles per day over the next 10 years. This level is assumed to be static thereafter. The growth is spread linearly over the 10 years at the rate of an additional 50 vehicles per day.

The logging truck volume is in Table 7.3 below.

Table 7.3 Logging truck volumes.

<table>
<thead>
<tr>
<th>Year</th>
<th>Per Day</th>
<th>Per Year</th>
</tr>
</thead>
<tbody>
<tr>
<td>0</td>
<td>450</td>
<td>164,250</td>
</tr>
<tr>
<td>1</td>
<td>500</td>
<td>182,500</td>
</tr>
<tr>
<td>2</td>
<td>550</td>
<td>200,750</td>
</tr>
<tr>
<td>3</td>
<td>600</td>
<td>219,000</td>
</tr>
<tr>
<td>4</td>
<td>650</td>
<td>237,250</td>
</tr>
<tr>
<td>5</td>
<td>700</td>
<td>255,500</td>
</tr>
<tr>
<td>6</td>
<td>750</td>
<td>273,750</td>
</tr>
<tr>
<td>7</td>
<td>800</td>
<td>292,000</td>
</tr>
<tr>
<td>8</td>
<td>850</td>
<td>310,250</td>
</tr>
<tr>
<td>9</td>
<td>900</td>
<td>328,500</td>
</tr>
<tr>
<td>10</td>
<td>950</td>
<td>346,750</td>
</tr>
<tr>
<td>11 to 25</td>
<td>950</td>
<td>346,750^5</td>
</tr>
</tbody>
</table>

Operational costs
The operational cost of HCV vehicles was calculated for two sections of the overall route. Section 1 is the Te Puke township (7 km), with Section 2 (the remaining 63 km) being labelled as the rural section. These data are given in Appendix 2.

^5 This equates to the 177,000 loads predicted by Forest Research Institute. 177,000 = 354,000 trips.
**Travel time**
Within the Transit framework, time is valued for the driver and for the vehicle and freight. Assumptions for calculating the travel time cost are given in Appendix 3.

**Accident savings**
The assumptions for accident savings have been calculated as the reduction in accidents due to reduced traffic volume, i.e. the accidents attributable to the logging truck traffic volume will be averted. Data are given in Appendix 4.

**Saved maintenance costs**
The Te Puke bypass study identified a maintenance cost per kilometre of $6,000 for the existing road. For this study it is assumed that 20% of this amount will be saved through the removal of HCV vehicles. Therefore the saved maintenance costs amount to $84,000 per annum.

A point to note is that the average cost per tonne of logs moved is $6.14 per tonne for the 70 km. Industry sources have quoted values of $6.50/m$^3$ to $8.50/m$^3$ which equates to $6.24$ to $8.16$ per tonne.

**Cost calculations**
As no rail investment cost was necessary and no operating costs provided, the cost calculations have been restricted to the do-nothing scenario. The costing for this scenario has been taken from the scoping study and adjusted for the differences in route length.

### Results
Table 7.4 presents the results from the analysis.

<table>
<thead>
<tr>
<th>Rail costs (($/tonne)</th>
<th>B/C</th>
<th>Incremental B/C</th>
</tr>
</thead>
<tbody>
<tr>
<td>0.5</td>
<td>14.20</td>
<td>8.75</td>
</tr>
<tr>
<td>1.0</td>
<td>7.1</td>
<td>5.41</td>
</tr>
<tr>
<td>1.5</td>
<td>4.73</td>
<td>3.92</td>
</tr>
<tr>
<td>2.0</td>
<td>3.55</td>
<td>3.07</td>
</tr>
<tr>
<td>2.5</td>
<td>2.84</td>
<td>2.53</td>
</tr>
<tr>
<td>3.5</td>
<td>2.03</td>
<td>1.86</td>
</tr>
<tr>
<td>4.5</td>
<td>1.58</td>
<td>1.48</td>
</tr>
<tr>
<td>6.0</td>
<td>1.18</td>
<td>1.12</td>
</tr>
<tr>
<td>7.0</td>
<td>1.01</td>
<td>0.97</td>
</tr>
</tbody>
</table>

Within the social cost-benefit framework, the rail option would be a preferred option if rail costs were less than the sum of road costs and the value of accident savings.
Without an actual rail cost a direct comparison is difficult. Initial indications suggest that the two modes may be very similar in pricing - but this is merely at a personal communication level although there appears to be a consistent understanding that rail is in fact price competitive.

Appendix 5 presents the detailed cashflow data.

Table 7.5 presents the results of the discounted cashflow analysis of rail option.

### Table 7.5 Net present value of rail option (rail cost $5/tonne).

<table>
<thead>
<tr>
<th>Discount rate</th>
<th>NPV (million)</th>
<th>B/C</th>
</tr>
</thead>
<tbody>
<tr>
<td>2</td>
<td>158</td>
<td>1.42</td>
</tr>
<tr>
<td>4</td>
<td>122</td>
<td></td>
</tr>
<tr>
<td>6</td>
<td>97</td>
<td></td>
</tr>
<tr>
<td>8</td>
<td>78</td>
<td></td>
</tr>
<tr>
<td>10</td>
<td>65</td>
<td></td>
</tr>
<tr>
<td>12</td>
<td>54</td>
<td></td>
</tr>
<tr>
<td>14</td>
<td>46</td>
<td></td>
</tr>
<tr>
<td>16</td>
<td>40</td>
<td></td>
</tr>
</tbody>
</table>

Based on the Transit NZ indicator discount rate of 10 percent, the use of rail within the assumptions specified has an economic advantage of $65 million at a rail freight cost of $5 per tonne. At the equivalent road freight price of $6.14 per tonne a gain of $29 million is predicted.

Given the assumptions presented it would appear that Transit NZ investment procedure is not operating in an economically efficient manner in that the full range of options are not being evaluated.

Appendix 6 graphically presents the net present value of the rail option for a range of rail costs.

This exercise is still comparing dissimilar investments. The road investment is made by the public whereas the rail investment is quasi-private. The positive net present values for rail operating costs of $6 per tonne and below suggest that there is potential to achieve greater efficiency by using rail. Interestingly, this could be with a zero or minimal investment by Transit compared to the $20 to $40 million investment into road.
7.6 Summary and discussion

The scoping report demonstrates the modal partiality referred to in this report in that it considers roading alternatives only for the problem being addressed. Other limitations of the planning viewpoint taken include the lack of a regional land transport perspective, and restriction of the problem definition to the Te Puke township congestion and accident rates. Environmental and planning issues are considered, but wider district and regional perspectives, land use issues, and strategic developments in the forestry industry are not considered.

Benefits associated with a rail option include reduced highway construction and maintenance expenditure, reduced fuel use (owing to rail's fuel efficiency advantage), reduced congestion and accident risks to road users, and reduced pollution both in the form of greenhouse gases and noise pollution in built-up areas on the logging truck routes.

The rail option considered in the case study shows that, under the stated assumptions, the NPV of rail ($65m) exceeds that of the preferred road option ($29m) by $36m. While the lack of adequate cost data for rail precludes a more rigorous analysis, the available evidence suggests that greater efficiency will be achieved under the rail option. There are a number of unanswered questions including:

- What is the cost of rail freight?
- What is required to achieve the substitution of one mode of transport for another?
- What is the actual objective of the road investments? (This is difficult to ascertain as each roading strategy has a different objective. Without a clear understanding of this the claims of enhanced economic efficiency cannot be justified as the objective may require a greater change to the mix and volume of traffic volume through Te Puke.)
- What are the true environmental costs of each option?
- What benefits would accrue to the residual road users from reducing congestion?
- Why does forestry use road if rail is price competitive?

The scoping report makes reference to a number of issues which are not considered in the formal CBA but which were considered by interested groups as being relevant to the investment decision. These included consideration of the rail alternative, long term traffic solutions, traffic needs of the wider area, overall transportation and economic issues of the region, and the effect on sacred Maori sites and tribal land.

Modifying the decision-making framework to encompass a transport services perspective, a regional land transport perspective, the views of a range of interest groups, and the selection of a least-cost solution from a set of options with a common objective will require a multi-criteria approach to transport investment analysis. In the transition from general planning to a form of planning that takes more account of conflict among different groups, evaluation occurs in a number of overlapping contexts. The process tends to be multiplicative rather than additive and cost-effectiveness analysis provides a useful step in making progress toward a normative planning model.
CHAPTER 8

Conclusion

Transport planning and transport investment in New Zealand are in transition. The historic emphasis on a supply oriented expansion of the transport infrastructure is no longer appropriate when faced with budgetary constraints and escalating environmental impacts.

This report has emphasised the need to focus more broadly on the supply of least-cost transport services, rather than the historic focus on aspects of the transport infrastructure. This means developing a planning and investment process that is mode-neutral, and enables demand-management options to be considered on an equivalent basis to options that involve increasing supply.

Recent regulations and policy initiatives affecting transport planning and investment are not inconsistent with this viewpoint. Statutes such as the Resource Management Act 1991 and the Land Transport Amendment Act 1992 will require transport options to be fully evaluated under an effects-orientated framework, and be consistent with the sustainable management of resources.

The new awareness of environmental and economic factors is out of step with management processes and methodologies used to determine transport investment priorities.

No single investment criterion is yet capable of adequately including all aspects of environmental costs and benefits in the decision-making process. This deficiency can be partly accommodated by extending the existing criteria to cover a wider range of impacts. Policy objectives together with a monitoring and evaluation procedure will provide the basis for incorporating environmental issues into the investment process.

Investment decisions that are currently made on the basis of a narrowly focused evaluation procedure use selection criteria that have major limitations in terms of ranking ability, timing, risk adjustment and strategic flexibility. One of the key issues that needs to be addressed in changing the investment process is the need to develop a more flexible approach, yet at the same time maintaining consistency within the evaluative process.

The balance between private versus public provision of transport services shows signs of shifting toward the former but there are substantial political, economic and technical barriers to overcome. While it is likely that private provision will increase in scale and across modes, public provision will continue where market failure occurs. Several areas of improvement in public investment decision-making have been identified.

Specific recommendations arising from this report include:

- Evaluative procedures used by Transit NZ are capable of improvement. The current cost-benefit framework can be enhanced through the adoption of a wider viewpoint, the development of a methodology that allows rail options to be considered on an equivalent basis to roading options, the incorporation of risk, and the addition of a cost-effectiveness approach.
- The scope of the output classes funded by Transit NZ needs to be broadened to accommodate the wider perspective of "transport service" investment.

- Further research should be done on improving demand-forecasting techniques, measurement of travel-time savings, impacts caused by transportation projects, use of non-market valuation techniques and use of option valuation methods.

- Transport managers should be encouraged to adopt a strategic management approach to investment planning. This would include monitoring key decision variables, establishing continuous real-time information systems for issue management to reduce risk and improve resource allocation decisions.
APPENDIX 1

Categories of impacts

1. Consequences of Inputs

a) Opportunities lost due to resource commitments.
b) Changes in employment.
c) Changes in real income.
d) Scarcities of material resources.
e) Promotion of previously unused resources.
f) Social disruption due to purchase of right-of-way.
g) Modification of human activity patterns and resource allocations due to taking of land parcels.
h) Others.

2. Consequences of performance outputs

a) Changes in community growth patterns.
b) Changes in market areas and competitive positions of various activities.
c) Social unification due to increased accessibility.
d) Expanded social, economic and cultural realms of people due to increased accessibility.
e) Modifications of human activity patterns and resource allocations due to changes in accessibility.
f) Changes in the prices of public and private goods due to changes in accessibility.
g) Changes in employment patterns due to changes in accessibility.
h) Lives and resources saved or lost due to changes in transportation safety.
i) Others.

3. Consequences of concomitant outputs

a) Social and psychological effects of creation or destruction of physical barriers by transportation facilities.
b) Aesthetic impacts of facilities.
c) Changes in crime rate created by transportation structures.
d) Physiological effects of air pollution due to transportation.
e) Psychological and physiological impacts of sound and light emitted by transportation vehicles and facilities.
f) Effects of changes in the safety properties of the interface between transportation facilities and their environments.
g) Modifications of human activity patterns and resource allocations because of changes in site characteristics due to concomitant outputs.
h) Others.

(Stopher and Meyburg, 1976).
APPENDIX 2

Assumptions for calculating the operating costs

The assumptions used for each section of road are:

<table>
<thead>
<tr>
<th>Item</th>
<th>Section 1 (km)</th>
<th>Section 2 (km)</th>
<th>Transit NZ reference</th>
</tr>
</thead>
<tbody>
<tr>
<td>Section length</td>
<td>7</td>
<td>63</td>
<td></td>
</tr>
<tr>
<td>Average speed (km/hr)</td>
<td>50</td>
<td>90</td>
<td>assumed</td>
</tr>
<tr>
<td>Roughness count</td>
<td>70</td>
<td>70</td>
<td>assumed</td>
</tr>
<tr>
<td>Roughness cost (cents/km)</td>
<td>18.24</td>
<td>18.24</td>
<td>Table A 2.14</td>
</tr>
<tr>
<td>Gradient average</td>
<td>0</td>
<td>0</td>
<td>assumed</td>
</tr>
<tr>
<td>Base operating cost (cents/km)</td>
<td>48.89</td>
<td>51.92</td>
<td>Table A 2.17</td>
</tr>
<tr>
<td>Minimum speed additional cost</td>
<td>20</td>
<td>50</td>
<td>assumed</td>
</tr>
<tr>
<td>Speed changes (cents/km)</td>
<td>4</td>
<td>12.8</td>
<td>Figure A 2.34</td>
</tr>
<tr>
<td>Section cost</td>
<td>$4.70</td>
<td>$44.21</td>
<td></td>
</tr>
<tr>
<td>Trip cost per 70 km</td>
<td></td>
<td></td>
<td>$48.91</td>
</tr>
</tbody>
</table>

APPENDIX 3

Assumptions for calculating travel time costs

<table>
<thead>
<tr>
<th>Item</th>
<th>Section 1</th>
<th>Section 2</th>
<th>Reference</th>
</tr>
</thead>
<tbody>
<tr>
<td>Section length</td>
<td>7</td>
<td>63</td>
<td></td>
</tr>
<tr>
<td>Average speed (km/hr)</td>
<td>50</td>
<td>90</td>
<td>assumed</td>
</tr>
<tr>
<td>Speed change time (seconds)</td>
<td>3</td>
<td>6</td>
<td>Figure A 2.33</td>
</tr>
<tr>
<td>Total trip time (minutes)</td>
<td>5.88</td>
<td>94.6</td>
<td>calculated</td>
</tr>
<tr>
<td>People present</td>
<td>1</td>
<td>1</td>
<td></td>
</tr>
<tr>
<td>Value of time ($/hr)</td>
<td>14.10</td>
<td>14.10</td>
<td>Table A 3.1</td>
</tr>
<tr>
<td>Value of vehicle/freight ($/hr)</td>
<td>22.70</td>
<td>22.70</td>
<td>Table A 3.2</td>
</tr>
<tr>
<td>Cost/hr ($)</td>
<td>36.97</td>
<td>36.97</td>
<td></td>
</tr>
<tr>
<td>Travel time cost ($)</td>
<td>2.17</td>
<td>34.81</td>
<td>calculated</td>
</tr>
<tr>
<td>Trip cost-time</td>
<td></td>
<td></td>
<td>$36.98</td>
</tr>
</tbody>
</table>

APPENDIX 4

Assumptions for calculating accident savings

<table>
<thead>
<tr>
<th>Item</th>
<th>Value *</th>
<th>Reference</th>
</tr>
</thead>
<tbody>
<tr>
<td>Year 0</td>
<td>0.11</td>
<td>calculated from traffic volume data</td>
</tr>
<tr>
<td>Year 1</td>
<td>0.13</td>
<td></td>
</tr>
<tr>
<td>Year 2</td>
<td>0.14</td>
<td></td>
</tr>
<tr>
<td>Year 3</td>
<td>0.15</td>
<td></td>
</tr>
<tr>
<td>Year 4</td>
<td>0.17</td>
<td></td>
</tr>
<tr>
<td>Year 5</td>
<td>0.18</td>
<td></td>
</tr>
<tr>
<td>Year 6</td>
<td>0.19</td>
<td></td>
</tr>
<tr>
<td>Year 7</td>
<td>0.20</td>
<td></td>
</tr>
<tr>
<td>Year 8</td>
<td>0.22</td>
<td></td>
</tr>
<tr>
<td>Year 9</td>
<td>0.23</td>
<td></td>
</tr>
<tr>
<td>Year 10 to 25</td>
<td>0.24</td>
<td></td>
</tr>
<tr>
<td>Accidents per 10^8 vehicle kilometres</td>
<td>25</td>
<td>Te Puke bypass scoping study</td>
</tr>
<tr>
<td>Non-injury/injury accidents</td>
<td>0.8</td>
<td></td>
</tr>
<tr>
<td>Fatal injuries/injury accidents</td>
<td>0.23</td>
<td></td>
</tr>
<tr>
<td>Cost of fatal injuries ($)</td>
<td>2,733,006</td>
<td>Table A 6.9</td>
</tr>
<tr>
<td>Serious injuries ($)</td>
<td>104,000</td>
<td>Table A 6.9</td>
</tr>
<tr>
<td>Non injury ($)</td>
<td>3,900</td>
<td>Table A 6.9</td>
</tr>
</tbody>
</table>

* 10^8 vehicle kilometres

<table>
<thead>
<tr>
<th>Year</th>
<th>Per Hour</th>
<th>Per Day</th>
<th>365 Per Year</th>
<th>Operating Cost Per Year</th>
<th>Travel Time</th>
<th>Accident Savings</th>
<th>Reduced Maintenance</th>
<th>Total Benefits</th>
<th>Do Nothing</th>
<th>Rail Costs</th>
<th>NCF Rail</th>
</tr>
</thead>
<tbody>
<tr>
<td>0</td>
<td>37.50</td>
<td>450</td>
<td>164250</td>
<td>8033725</td>
<td>6073815</td>
<td>415365</td>
<td>84000</td>
<td>14607704</td>
<td>105000</td>
<td>10265625</td>
<td>4342078.98</td>
</tr>
<tr>
<td>1</td>
<td>41.67</td>
<td>500</td>
<td>182500</td>
<td>8926361</td>
<td>6748481</td>
<td>462627</td>
<td>84000</td>
<td>16221449</td>
<td>105000</td>
<td>11406250</td>
<td>4815198.87</td>
</tr>
<tr>
<td>2</td>
<td>45.83</td>
<td>550</td>
<td>200750</td>
<td>9818997</td>
<td>7423307</td>
<td>508890</td>
<td>84000</td>
<td>17835194</td>
<td>105000</td>
<td>12546875</td>
<td>5288318.75</td>
</tr>
<tr>
<td>3</td>
<td>50.00</td>
<td>600</td>
<td>219000</td>
<td>10711633</td>
<td>8098153</td>
<td>555153</td>
<td>84000</td>
<td>19448939</td>
<td>105000</td>
<td>13887500</td>
<td>5781438.64</td>
</tr>
<tr>
<td>4</td>
<td>54.17</td>
<td>650</td>
<td>237250</td>
<td>11604269</td>
<td>8772999</td>
<td>601416</td>
<td>84000</td>
<td>21062664</td>
<td>105000</td>
<td>14828125</td>
<td>6234558.53</td>
</tr>
<tr>
<td>5</td>
<td>58.33</td>
<td>700</td>
<td>255500</td>
<td>12496905</td>
<td>9447845</td>
<td>647678</td>
<td>84000</td>
<td>22676428</td>
<td>105000</td>
<td>15968750</td>
<td>6707678.41</td>
</tr>
<tr>
<td>6</td>
<td>62.50</td>
<td>750</td>
<td>273750</td>
<td>13389541</td>
<td>10122691</td>
<td>693941</td>
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APPENDIX 6

Net present value of rail

Figure A6.1  Proposed rail option, benefit/cost ratio for a range of rail costs.

Figure A6.2  NPV rail cost $1.5/tonne.

73
PROPOSED RAIL OPTION
NPV RAIL COST $4/T

Figure A6.3  NPV rail cost $2.5/tonne.

PROPOSED RAIL OPTION
NPV RAIL COST $5/T

Figure A6.4  NPV rail cost $4/tonne.
References


Peterson, D. 1990. Sustainable use of transport resources. *New Zealand Engineering (June)*: 9, 10.


Young, D. 1992. (pers. comm.)