Executive Summary

Transfund New Zealand (Transfund) is the New Zealand (NZ) government agency responsible for allocating central government funds to road construction and maintenance projects, alternatives to roading projects, and passenger transport services. Transfund’s mission is to “achieve the greatest benefit to road users and the nation from every dollar spent”. To do this, Transfund uses cost-benefit analysis to determine the majority of its capital investment priorities.

This paper describes a review that Transfund has initiated of the “project evaluation benefit parameter values” used to evaluate road and passenger transport projects. We believe this review is somewhat unique, because Transfund is trying to establish values for many of the primary benefit parameters in combination by undertaking stated preference conjoint analysis using willingness to pay surveys. In other words, we are asking transport users to value the benefits they receive from making trips by trading-off one set of benefits against other sets of benefits, such as safety versus travel time.

In particular, Transfund is wanting to establish New Zealand specific values for car, truck and passenger transport users for work time, non-working time - including commuting time, congestion and reliability, trip comfort - including ride quality, safety measures (and risk perception), and for commercial vehicle operators the value of freight time. This is needed because the current Transfund benefit parameter values have been established over many years and are based on a mixture of overseas and domestic data, some of which is over ten years old.

Because we believe that this review is pioneering in nature (it is valuing so many parameters at the same time), we welcome feedback from individuals and organisations on the work programme we have proposed. It is possible that some countries or jurisdictions may have
undertaken work that is similar but that has not been published (or has not been located by us), and we welcome communication with them.

By the time of the IRF conference in June 2001 we will have progressed our review further than is presented in this paper, and any major developments will be presented orally at the conference. In particular we anticipate that we will have completed the survey piloting and started the main surveys.

Prior to commencing this review we undertook extensive consultation with representatives and key stakeholders of the New Zealand transport industry. The review work is being managed in such a way as to allow the transport industry to have input and shape the direction of the project.

We are forecasting that the likely new values for congestion, reliability, ride comfort, and safety improvement, will result in some redistribution of the project benefits, and result in more congestion relief projects being undertaken in urban centres and more ride and safety improvements justified for the higher volume rural roads.

This project has required a significant commitment of resources from Transfund and the transport industry. However, this commitment is more than justified given that the project benefit values drive approximately NZ $1.5 billion per annum in project benefits. The results, when implemented, are expected to form the basis of project evaluation procedures that should last for 10 years or more.

This paper sets out the background to the review of benefit parameter values and the work programme that has been commenced and is currently underway, together with some of the implementation issues that will need resolving.

Martin Gummer
Chief Executive, Transfund New Zealand (Wellington, New Zealand).

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Introduction

Transfund is reviewing the values it applies to transport user benefits in the evaluation of road and passenger transport projects. At the time of submitting this paper the work is in its early stages. This paper reports on the work undertaken to date, together with forecasts of the potential outcomes of the review and issues surrounding the implementation of these results.

The work is being undertaken by a consortium of New Zealand and overseas specialist consultants, with direction and guidance from Transfund and its specialist advisors. The consortium consists of the following companies and lead personnel:

- Beca Carter Hollings & Ferner Ltd, of Auckland, New Zealand, (Ian Bone), lead consultants;
- Steer Davies Gleave, of London, England, (John Swanson), transportation consultants responsible for the design and analysis of the stated preference surveys;
- Forsyte Research, of Auckland, New Zealand, (David Glover), market research consultants, responsible for survey implementation;
- Brown Copeland & Co, of Wellington, New Zealand, (Mike Copeland), consulting economists for responsible providing general advice and for the valuation of work travel time savings.

Throughout the review Transfund is maintaining dialogue and consultation with the New Zealand transport industry and its key stakeholders. This communication includes allowance for the industry to input into the project and shape the direction of the review.

Background

Transfund is the New Zealand government agency responsible for allocating central government funds to road construction and maintenance and passenger transport services. Transfund was established in July 1996 under the Transit New Zealand Amendment Act and became a fully independent government agency in July 1997, the first year (1996/97) being an establishment year. Transfund’s mission statement is to “achieve the greatest benefit to road users and the nation from every dollar spent” by:

- operating a fair and transparent allocation process
- funding areas of highest return
- ensuring value for money; and
- ensuring incorporation of safety features in roading.

Transfund allocates funds for road construction, road maintenance, alternatives to roading, and passenger transport. The amount of funding Transfund allocates to projects is directly related to its revenue. The number of potentially worthwhile projects submitted to Transfund usually exceeds the funds available. For this reason, Transfund has to rank projects in order of priority on a national basis, and uses social cost benefit analysis (CBA) for this ranking. Project funding currently requires road construction projects to have a minimum benefit-cost ratio (BCR) of 3.0. Previously the BCR cut-off for funding was 4.0 and this is re-evaluated each year in the light of revenue projections.
Review of Cost Benefit Analysis

One of the first tasks undertaken by Transfund in 1997 was to review its project evaluation procedures. This review considered evaluation theory and international best practice, and confirmed CBA as the most appropriate method for evaluating roading infrastructure projects. Having determined that CBA is the best tool to use, Transfund decided to review the scope of the benefit parameters included in its evaluation procedures, together with the monetary values attached to those parameters. Stage 1 of this review commenced in September 1999.

Reasons for the Review of Benefit Parameters

The benefit parameter values provided in Transfund’s Project Evaluation Manual (PEM) are the core determinant of the allocation of approximately NZ $400 million\(^1\) per annum of New Zealand central government funds to road construction projects. Transfund also has procedures for evaluating alternatives to roading projects (i.e. rail passenger transport, harbour ferries, freight barging, etc) where these can be shown to be more efficient than road improvements, plus procedures for evaluating passenger transport services.

Thus, it is critical that the benefit values contained in Transfund’s evaluation procedures accurately reflect transport users’ preferences. Some of the feedback from transport users suggests that the current values may not be as reliable, consistent or complete as they should be. The current evaluation procedures contain benefit values that have been determined from a variety of sources and theoretical frameworks. Some of these values are based on overseas research and practice and some are potentially outdated.

Industry feedback indicates that the current benefit parameter values do not always result in the selection of projects that road users want. For example, many people would like to see more construction of passing lanes on two lane rural roads, and more projects to relieve congestion than are currently being undertaken. Part of the reason that these projects are not being funded is that they do not generate enough benefits (using the current benefit values) to meet Transfund’s funding criteria.

New benefit parameter values derived from this review should result in a different mix of projects being funded, which should more closely align investment decisions with transport users’ preferences.

In summary, this review is intended to revise the project evaluation benefit parameters to better reflect the preferences of New Zealand transport users by obtaining up-to-date New Zealand specific values that have been valued conjointly.

Note: There is a parallel stream of work associated with this project that is considering the valuation of environmental and other externality factors and how these are incorporated into the cost benefit analysis framework. This paper does not describe this parallel work.

\(^1\) The exchange rate is NZ $1 = US $0.41 = Euro 0.46 as at 31 March 2001.
Output from Stage 1 of the Review

Stage 1 was a programme of pre-research to scope the work that would be necessary to ensure the greatest chance of success for this review.

The Stage 1 work was undertaken by Transfund, with assistance from the following specialists: David Ashley and Ray Winn, Sinclair Knight Merz, Australia; Professor David Hensher, University of Sydney, Australia; Professor Peter Abelson, Macquarie University, Sydney, Australia; Dr Charles Sullivan, BRC Market Research, Wellington, New Zealand; and Ted van Geldermalsen, Transit New Zealand.

There were five outputs from Stage 1 of the review:

1 Literature Review

The literature review indicated the pioneering nature of the work being proposed. Although many international road jurisdictions have considered road user preferences and how to value them, none to our knowledge, has attempted to value the majority of benefit parameters relative to one another within a single study.

2 Report on the Economic Principles

A report by Professor Peter Abelson, confirmed that willingness to pay (WTP) is the correct approach for valuing benefit parameters within a cost benefit analysis framework. Professor Abelson emphasised that market prices for goods represent users’ WTP for that product, and advised that a series of market surveys which allow interviewees to trade off the non-market parameters against those with a clear market value would be the best approach for Stage 2.

3 Report on Valuation Method

A research report\(^2\) was produced on the methodologies that can be used to value benefit parameters. It concluded that multi-variate conjoint analysis using stated preference (SP) techniques is the optimal method of valuing transport users’ preferences. This involves surveying users and asking them to choose between varying combinations of benefits, one of which has a market value and inferring the values for the non-market benefits from statistical analysis of the responses.

4 Parameters to Include in the Review

Interviews with individual road users and focus groups, together with nation-wide industry consultation, formed the basis for selecting the parameters to include in the review. The feedback indicated that road users place a high value on smooth, unimpeded traffic flow. Emotional comfort was also found to be an important component of driver preferences. The response from road users and industry

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2 A Transfund New Zealand Research Report has been produced entitled “PEM Benefit Parameter Project: Development of Research Approaches” by Booz Allen & Hamilton (New Zealand) Ltd, November 2000.
representatives suggested many parameters that could be included in Stage 2 of the review, but the most important of these were travel time, congestion, reliability of journey time, ride comfort and perceived safety.

5 Strategy for Stage 2

The strategy for Stage 2 is to use stated preference surveys to value:

- for private vehicle users:
  - travel time, congestion, reliability of journey time, ride quality and perceived safety

- for users of suburban rail and bus services:
  - travel time, crowding, reliability of journey time, wait and walk time, and interchanges (need to change vehicles)

- for commercial vehicle shippers/operators:
  - time savings, reliability of journey time, ride quality and road geometry.

Note: The Stage 2 strategy does not include a review of the value of statistical life. However, we believe that the valuation of safety measures (perceptions) will provide insights into the relativity between safety and the other benefit measures.

Stage 2 Project Objectives

The overriding objective of this review is to obtain rigorous, defensible, up-to-date, New Zealand specific, benefit parameter values that draw on international experience and best practice, and that have acceptable compliance costs when evaluators apply them to project evaluations.

Expanding on the Stage 2 strategy set out above, the specific objectives are to:

(a) revise the current benefit parameter values contained in Transfund’s project evaluation procedures (that are currently based on outdated or overseas data);

(b) identify and value any significant additional benefit parameters that are not currently included in Transfund’s project evaluation procedures;

(c) benchmark all the revised and additional benefit parameter values to determine the levels of confidence which may be placed on them; and

(d) ensure that the revised and additional benefit parameter values are applicable at reasonable cost, in the light of transport modelling practice in New Zealand.
Stage 2 Strategy / Programme

Survey Scope

A total of 1200 Stated Preference interviews with private vehicle users is planned, 400 Stated Preference interviews with bus and rail users, and 150 Stated Preference interviews with freight transport operators/shipper\(^3\). Each interview will involve two or three separate Stated Preference games within a practical interview time, to cover combinations of the various travel attributes and maximise the data for analysis.

In addition, 600 telephone surveys will be undertaken to investigate in-travel use of work time and the use of work travel time savings for non-work purposes.

Geographic Spread

The geographic spread of the surveys will cover four major urban centres and six smaller urban centres throughout New Zealand, in order to obtain representative samples.

Survey Method

Transfund has been cautious when deciding whether to use the household interview or hall intercept survey method. The hall intercept method involves randomly selecting people passing a certain point (i.e. in a railway station or in a shopping mall). Important issues considered in the selection of survey method included balancing quality control concerns against potential response bias. Every effort will be made to minimise sample and response biases. While the decision on survey method will be decided after the pilot surveys are completed, it is likely that household interviews will be used for the private car user surveys and the hall intercept method for the public transport surveys.

Survey Design

All survey designs will be assessed for boundary values. Robustness will be established using simulation tests and all surveys will be extensively piloted. The Stated Preference interviews will be conducted using computer-aided personal interviewing (CAPI) techniques developed by Steer Davies Gleave. The interviewing format will maintain realism by customising the surveys to the circumstances of each respondent. The general format of the Stated Preference interview is as follows:

- respondents will be asked to identify a recent trip made of the required type and supply details of the trip such as the origin/destination, trip purpose, mode(s) used, journey travel time and the trip costs or fare paid
- up to three Stated Preference paired-choice games will be offered to the interviewee
- at the end of the exercise, demographic questions will be asked to establish population profiling details.

\(^3\) New Zealand has a population of 3.8 million and 3.25 million registered vehicles, of which 95,700 are commercial vehicles and buses of greater than 3.5 tonnes.
Survey Analysis

Data will be analysed using software which estimates logit model parameters using maximum likelihood. Tabulations of the sample profile will be provided to enable the profile to be compared to reference sets from previous research. In this way, any sampling biases can be identified and corrected by re-weighting the data set.

The technical analysis will provide definitions of utility functions estimated for each Stated Preference exercise, as well as:

- estimates of all parameter values, including t-ratios and rho-bars
- estimates of values of time, quality, reliability and all other attributes (estimates of confidence limits for these values will also be made)
- breakdowns of the above by segments as required.

Acceptance Criteria

Criteria for the acceptance of results will be developed as the project proceeds. However, the acceptance criteria are expected to include:

- eliminating any clearly inconsistent results
- discarding illogical outliers and incomplete records in the survey data
- comparisons with overseas research to ensure the results are not inconsistent with other well-established findings.

Where there has been a degree of consistency in overseas research with regard to a particular aspect or parameter(s), that any conflicting result would not be accepted, consideration will be given as to whether or not the particular parameter should be included in the survey.
Valuation of Road User Benefit Parameters

This section sets out the various ways that road user benefits are represented and valued in the Stated Preference surveys.

Monetary Benchmark

The payment vehicle in the road user Stated Preference designs will be a direct charge for use of the roadway. For this project we will use fuel costs and parking charges.

Representation of the Value of Time

Time savings or losses will be assessed for free-flow conditions. Careful attention has been paid to the definition of free-flow conditions in the survey design to ensure high levels of comprehension among respondents.

It has been found that when small time variations are offered in Stated Preference surveys they tend to be valued disproportionately less than larger variations. Respondents may perceive little value in very small time savings, even though these may accumulate to substantial amounts. Consequently, the Stated Preference survey designs for this exercise will exclude time variations of less than one minute.

The Stated Preference survey design will endeavour (to the extent that this is possible) to ensure that time values are elicited for journey lengths similar to those to which the values will be applied in practice.

Value of Time: Preliminary Survey Design Draft - Subject to Change

<table>
<thead>
<tr>
<th>Journey A:</th>
<th>Journey B:</th>
</tr>
</thead>
<tbody>
<tr>
<td>Drive time:</td>
<td>10 minutes</td>
</tr>
<tr>
<td>Cost of the trip:</td>
<td>$9.30</td>
</tr>
</tbody>
</table>

Which of these two journeys do you prefer?

[Definitely A] [Possibly A] [Can't choose] [Possibly B] [Definitely B]
Representation of Congestion and Reliability

Given that an increase in congestion influences the reliability of journey time, congestion and reliability are clearly related attributes, although the travel qualities that they represent are distinct. Road users exhibit an aversion to driving in congested traffic, as well as an aversion to unreliability in journey time. The intention of the study is to determine separate values for congestion and reliability although, when the values are applied in practice, it may be that one can be described as a function of the other for the generality of project evaluations. However, there are cases, such as traffic incident detection and management schemes, where improved reliability is sought while also maintaining high traffic volumes.

Preliminary research in Stage 1 confirmed the existence of a measurable difference in value between congestion and reliability in New Zealand. Interestingly, the preliminary research showed that time spent stationary was valued very highly (i.e. large disbenefit) by commuters, and even higher for non-commuter trips. In addition, contingency time was found to vary between 16% and 42% of overall journey time. These results suggest that congestion may have a higher value than that currently allowed for in Transfund’s present procedures, which provide for weights of up to 25% extra for degrees of congestion.

Concern was expressed to Transfund (by some industry representatives) at the potential differences in the cost of congestion in the different areas. For example, people in Auckland may be more conditioned to congestion than people living in smaller cities, and as such, the cost of congestion may be relative. Alternatively, people in provincial cities may have less tolerance of delays because they occur less frequently. We are furthering this issue by developing a position paper on equity issues.

The treatment of reliability in the Stated Preference surveys is currently under consideration. The concept of delay distributions is one method of presenting journey time reliability. Delay distributions involve showing respondents hypothetical travel times over a number of days, with the times varying according to a prescribed rule. Respondents are told that this ‘diary’ represents their experience over a number of days, and are asked to compare two such diaries, one with low variance and one with higher variance. Thus, the Stated Preference survey will request respondents to choose between a trip with congestion and delays, and a longer and more expensive trip free of delays.

One difficulty in using this method, however, is that it is only possible to present a limited number of days in the Stated Preference survey. It is therefore difficult to cover trips with a low probability of delay. Also, the ability of respondents to mentally process this information in a meaningful way is doubtful. While the distribution is taken to imply a mean and standard deviation, users may only perceive the highest value in the selection and be influenced by this. There is also a problem with responses being influenced by the ordering of the values.

An alternative design method is being considered, which relies upon the respondent stating his/her expected travel time and then being offered choices based on this expected travel time, which “could be up to X or Y minutes late”. While easier for the respondent, this approach leaves some uncertainty in the interpretation of the results.
Representation of Ride Comfort

This attribute will measure the value of the improved ride quality associated with reduced surface roughness. Currently, the main purpose of the road roughness measurement is to assess its contribution to vehicle operating costs. However, roughness measures were originally designed to assess ride quality from the passenger perspective, but this user comfort value has been lost sight of in the current evaluation procedures.

Given the close association between surface roughness and ride quality, it is important not to double count vehicle operating cost effects when using passenger values of ride comfort. The Stated Preference survey questions will be framed as far as possible to remove the roughness-related vehicle operating cost from consideration.

For practical application, it is essential that any subjective assessment of ride quality is able to be mapped against standard roughness measurements. Ride quality depends on both vehicle suspension and the road vertical profile along the wheel track. Hence, the relationship between passenger comfort and road surface roughness will be specific to the vehicle type in which the interviewee made their trip.

The survey design will represent ride comfort as physical effects on activities inside the vehicle. These may include the effect on conversation, and the ease or difficulty of undertaking physical tasks such as writing or drinking from a cup.
Unpaved roads will be excluded from the survey, on the basis that they carry only one per cent of the vehicle-kilometres travelled in New Zealand, and because they introduce a number of other confounding user preferences such as surface looseness and dust nuisance.

**Ride Comfort: Preliminary Survey Design Draft - Subject to Change**

![Alternative A](continuous_vibration_no_rutting)  
**Alternative A:**  
- Continuous vibration.  
- No rutting.  
- **Drive time:** 15 minutes

![Alternative B](continuous_vibration_ruts_affecting_steering)  
**Alternative B:**  
- Continuous vibration.  
- Ruts affecting steering.  
- **Drive time:** 10 minutes

**Which of these two alternatives do you prefer?**

- Definitely A  
- Possibly A  
- Cannot choose  
- Possibly B  
- Definitely B

**Representation of Perceived Safety**

Preliminary research in Stage 1 found that perceptions of danger and lack of safety are major causes of driver discomfort. The high intensity of the discomfort regarding perceived safety concerns suggests that users’ willingness to pay to reduce the associated stress may also be high.

The output from this survey concerns the value of road users’ anxiety about traffic and road design features that are additional to the objective valuation of accident risk. The project aims to develop a Stated Preference exercise to obtain values for these road user perceptions, trading off improvements in perceived safety against time. In doing so, it is recognised that road users’ perceptions will in some cases underestimate the objective safety risk, while in other cases, the objective safety risk may be small while the discomfort is high. (The objective risk may be lower for this very reason, as the road condition seems less safe to users, and they take more care accordingly). In the first case, the objective safety risk could remain the basis for valuation of safety improvements. In the latter case, where the user-perceived value is greater than the objective risk, the latter may form the basis for evaluation. The final decisions on this issue are still to be taken.
We propose to present general attributes of roads and traffic that can be related to road safety. Safety perceptions are taken to be a combination of:

- available traffic width (width of sealed traffic lane and shoulder)
- roadside hazard rating (related to side slope and roadside obstructions)
- road geometry (from predictable and well-engineered to unpredictable and poorly engineered).

The survey designers have suggested that the Stated Preference survey be designed to estimate an adjustment to the value of time for each of these features. Each of the three safety attributes above will have three levels of safety. For example, traffic width will be described (with supporting photos) as follows:

- the lane is X metres wide. This leaves about Y metres on each side of the vehicle. You need to use a normal level of mental concentration to stay within the boundaries.
- the lane is X metres wide. This leaves about Y metres on each side of the vehicle. You need to use a moderately high level of mental concentration to stay within the boundaries.
- the lane is X metres wide. This leaves about Y metres on each side of the vehicle. You need to use a highly sustained level of mental concentration to stay within the boundaries.

The lower safety option will present different levels of safety for each of the three attributes outlined above, and use a constant driving time of 10 minutes. The higher safety option will have good safety conditions for all three attributes and a longer driving time. Thus, each paired alternative will ask respondents to trade off a longer driving time in safe conditions with a shorter driving time in poorer safety conditions.

This Stated Preference exercise only applies to rural conditions, since the safety attributes described are not applicable for urban conditions. Drivers who report a trip which occurred predominantly on urban roads will be excluded from this exercise.

Example of a preliminary survey design draft is given below.
Perceived Safety: Preliminary Survey Design Draft - Subject to Change

Alternative A:
- No trees, poles or rocks at roadside
- No sharp blind bends

Drive time: 17 minutes

Alternative B:
- Trees and/or power poles every few metres
- Sharp blind bends every few minutes

Drive time: 10 minutes

Which of these two alternatives do you prefer?
- Definitely A
- Possibly A
- Cannot choose
- Possibly B
- Definitely B
Valuation of Parameters for Public Transport Users

Preliminary research undertaken in Stage 1 identified numerous service quality attributes that could be assessed. Due to practicality and cost issues, however, Stage 2 will focus on values for service reliability and crowding. Benefit values will be obtained for bus services in urban areas and for suburban commuter rail services. Interviews with 200 bus users and 200 rail users will be conducted, split equally between commuters and other non-work trip purposes.

The public transport attributes to be assessed are values of time measures for in-vehicle time; access and egress time; waiting time; interchange penalties; and headway. All the public transport Stated Preference surveys will use a selected trip provided by each respondent.

Travel Time, Fare, Headway and Interchange

The primary attribute to be valued is the in-vehicle value of time. This will be defined as the total time spent travelling on the bus(es), excluding interchange time where changing services is required. Fares will be the monetary benchmark used, and will be based on the actual fare each respondent paid for their selected trip. Headway refers to the scheduled interval between buses. Interchange will be presented in some exercise and not others.

Passenger Transport: Preliminary Survey Design Draft - Subject to Change

<table>
<thead>
<tr>
<th>Journey A:</th>
<th>Journey B:</th>
</tr>
</thead>
<tbody>
<tr>
<td>Time on bus: 25 minutes</td>
<td>Time on bus: 20 minutes</td>
</tr>
<tr>
<td>Buses run every 15 minutes</td>
<td>Buses run every 20 minutes</td>
</tr>
<tr>
<td>One-way fare: $ 1.00</td>
<td>You must change buses (5 minutes wait)</td>
</tr>
<tr>
<td>One-way fare: $ 1.50</td>
<td></td>
</tr>
</tbody>
</table>

Which of these two journeys do you prefer?

- Definitely A
- Possibly A
- Cannot choose
- Possibly B
- Definitely B
Crowding and Reliability

Crowding and reliability are two distinct trip attributes which will, however, be assessed in the same Stated Preference exercise. Crowding will be treated as a modifier to the value of travel time. Service reliability is defined as the level of adherence of a public transport service to a published schedule. Reliability will be valued as a lump sum to be added to the cost of a journey. The value of the overall sum will depend on the degree of unreliability, with an associated penalty for each level of unreliability offered relative to a base value of reliability.

The Stated Preference survey design will present three levels of crowding and reliability. Respondents will be asked to assess the level of crowding on their selected service. The three levels of crowding are described as follows:

- seats are freely available and passengers do not have to sit next to anyone else
- seats are available but passengers have to sit next to someone else or stand; movement within the bus is not restricted
- no seats are available and passengers must stand for the entire journey; movement within the bus is difficult.

Respondents will also be asked to assess the reliability of their selected service using the three levels of reliability outlined below:

- all buses arrive on time according to the schedule
- buses may be up to 2 minutes late
- buses may be up to 5 minutes late.

The in-vehicle travel times pivot around the travel time of the respondent’s selected trip using proportional changes. The penalty associated with crowding is related to the time spent in crowded conditions. These levels are based on the idea of “expected lateness”, which uses the passenger’s past experience of the bus service to ascertain reliability. This avoids the difficulties of probability of distribution of delays. Note that this proposed design measures reliability in terms of expected journey time.
Crowding and Reliability: Preliminary Survey Design Draft - Subject to Change

**Alternative A:**
- Buses arrive up to 5 minutes late
- You can choose a seat freely
- Time on bus: 23 minutes

**Alternative B:**
- All buses arrive on time according to schedule
- No seats are available, you will have to stand
- Time on bus: 20 minutes

Which of these two alternatives do you prefer?

[Definitely A] [Possibly A] [Cannot choose] [Possibly B] [Definitely B]
Valuation of Commercial Vehicle Operator Parameters

The commercial vehicle operator Stated Preference exercises are:

- value of time, using trade-offs between time and money (similar to that for the road user Stated Preference exercises but with a higher value of time)
- reliability, using trade-offs between time, cost and reliability of delivery time
- ride quality and road geometry.

Sample Framework

A final sample of 150 freight operators is targeted. Freight carriers will be over sampled to ensure that there are sufficient responses to undertake an analysis. Those individuals making decisions on vehicle usage will be interviewed. Identifying the appropriate decision-maker is an important issue to be considered, especially given that decision making may be shared by up to three parties in larger freight transport companies.

Experimental Design Considerations

The commercial vehicle operator Stated Preference exercises are similar to the road user Stated Preference exercises, with selected attributes and other details tailored to meet the priorities and concerns of freight transport operators. Such concerns include vehicle stability on corners.
Work Time Valuation

Marginal Productivity of Labour

In Stage 1, it was decided to retain the marginal cost to the employer of an employee’s time (the marginal productivity of labour, MPL) as the basis for valuing travel time savings during paid working time. The calculation of the MPL requires:

- rates of pay for different categories of employment
- costs borne by the employer (e.g. accident compensation levies, goods and services tax)
- non-wage employee benefits (e.g. pensions, paid leave).

This approach assumes that travel time during work hours is unproductive, that all time savings are deployed into productive work, and that the employee is indifferent between spending time travelling or at work. Increasingly, this is no longer the case, if it ever was, and some work travel time will be used less productively than time at the workplace, or be used for non-work purposes. Also, some work travel time savings will be deployed to non-work purposes.

Two areas of work are to be undertaken:

- the MPL values will be reviewed and recalculated
- surveys will be designed and undertaken to determine the extent to which adjustments for uses of travel time and travel time savings are required.

Productivity of Work Travel Time

We wish to determine the productivity of work travel time, and the proportion of travel time savings made in work time that are used for non-work purposes.

Business travellers will be surveyed by telephone interviews, and asked about their latest trip made in work time during the previous week. The sample size of 600 will enable sub-groups to be analysed, such as passengers versus drivers and private cars versus taxis or other public transport, providing more robust average values. Typical trip frequency data will be collected to enable the data to be modelled and to determine average values. When the survey analysis is undertaken these trip frequency data may be weighted by the following factors: industry sector, occupational groups, and business size.

Further analysis of existing New Zealand data sources will be undertaken to establish values of work travel time for different occupational groups.
Project Communication and Consultation

Throughout this review of benefit values Transfund is maintaining dialogue and consultation with the New Zealand transport industry and its key stakeholders, through:

- a series of initial consultation workshops with transport industry representatives and key stakeholders, held throughout New Zealand in early 2000
- a project consultation committee consisting of representatives from local government, Automobile Association, Road Transport Forum (for commercial vehicles), other government agencies including the Land Transport Safety Authority, Transit New Zealand (which manages the State Highways), the Ministry of Transport, and the Treasury
- a project review e-mail service, contact details are julie.booker@transfund.govt.nz
- Transfund Updates (project newsletters) – the November 2000 Update was posted on the Transfund web-site
- reporting to the 74 road controlling authorities (Transit New Zealand plus 73 territorial local authorities) at their half-yearly forums
- articles in the Transfund News information service (when appropriate).

Project Technical Management and Overview

One of the main forms of quality control for this project has been the establishment of a Technical Working Group. This group was formed with the objective of providing quality control and technical management, as well as technical reviewers to advise Transfund and the Consortium of any areas of concern.

The Technical Working Group consists of technical advisors and international experts, including:

David Ashley - traffic modelling and transport user survey expert from Sinclair Knight Merz, Australia
Ray Winn - traffic modelling expert from Sinclair Knight Merz, Australia
John Bates - stated preference design expert from United Kingdom
Dr Charles Sullivan - market research expert from New Zealand
Prof David Hensher - academic expert on stated preference surveys from University of Sydney, Australia.
Progress to be reported at IRF Conference

By the time of the IRF World Road Congress, 11-15 June 2001, we will have progressed our review further than is presented in this paper, and any major developments will be presented orally at the conference. In particular, we anticipate that we will have completed the survey piloting and will have started the main surveys.

Summary

In summary, this project has been initiated because Transfund wants to ensure that its project evaluation benefit parameter values reflect New Zealand transport users’ values and preferences, while at the same time ensuring that the methods used to obtain these values are consistent, robust, and stand up to scrutiny. In undertaking this work we have sought out international best practice and engaged experts in this area of research.

The output from this work is intended to be the backbone of project evaluation procedures and benefit values that will determine Transfund’s funding allocations for road projects, alternatives to roading projects, and passenger transport services for the next ten years or more.

Because the work is in progress and some of the Stated Preference designs are still in draft form, it is possible that the project direction and outputs may change slightly from that set out in this paper. We welcome communication from other road jurisdictions that may have tried to undertake a similar exercise or who are contemplating similar work.

Disclaimer

The views expressed in this paper are entirely those of the authors. They should not be relied upon as representing the views of Transfund New Zealand or the New Zealand Government and are expressed without any responsibility on the part of the authors, Transfund New Zealand and/or the New Zealand Government.
Appendix 1

Implementation Issues

A number of issues have been identified as needing consideration before the revised benefit parameter values may be incorporated into Transfund’s project evaluation manual (PEM) and other evaluation procedures. These issues relate to the availability and measurement of data, additional analysis requirements and analysis complexity and are outlined below for each of following parameters:

- road user travel time values
- public transport user time values
- congestion and reliability
- ride quality
- safety perceptions.

Work Travel Time

The output from the analysis of the marginal cost of labour will be hourly economic costs of employment by occupational and/or industry groups, with certain categories such as professional drivers identified more specifically in the analysis.

The current procedures rely on an association between occupation type and industry groups and passengers and drivers of each vehicle type (cars and light, medium and heavy commercial vehicles). This original analysis was established about 20 years ago. For heavy commercial vehicle drivers (trucks and buses), the MPL values for these occupations can be used directly. However, for cars and light commercial vehicles, more information will be needed on the make-up of the traffic stream. An estimate can be made based on the proportion of each occupation/industry type in the working population. This ignores the propensity of some occupations to travel more than others in the course of work (commercial travellers being an obvious example), and for geographic and urban/rural variation. Transfund will need to undertake supplementary surveys to establish typical values and the range of variation for standard vehicle types and traffic make-up.

It is anticipated that, apart from the annual indexing of wage rates using standard indexes, reanalysis would be required at no more than five-yearly intervals and a maximum of ten yearly intervals.

Road User Non-Work Time

Currently, the PEM specifies proportions of work and non-work time, and provides mean values by time of day (e.g. peak and off-peak). In the new procedures, non-work time will be divided into commuting and other trip purpose.

The non-work value of travel time will be expressed in dollars and cents per hour using current dollar values (i.e July 2002 values when these results are implemented). Updating will be conducted by indexing the values to reflect the rate of general inflation in goods and
services against which willingness-to-pay values were established. This ignores any change in the relative value of time and traded goods over time. Historically, time values appear to have increased, if measured against the benchmark of wage rates. In the 1960s, the consensus was a value of about 25% of the wage rate, and in the 1980s a value of 40% of the wage rate. This includes changes in inflation-adjusted mean wage levels over time, but does not take any account of changing income distribution.

Transfund proposes to re-survey traffic flow data more frequently than at present. Transfund is currently developing a Transport Information System, which will collect vehicle occupancy data. Trip purpose data will be able to be added as new surveys are processed, with updates of standard values made by road type.

Public Transport Non-Work Time

In a manner similar to that described above, data by time of day will be required for bus and rail passenger non-work travel. This data will be more readily available than road user data, as Regional Councils regularly conduct public transport user surveys for regional transport network models. Commuting is always identified as a separate trip purpose. Education trips are also normally identified, and these will be ascribed a lower time value (not included in this project design) that is notionally half or one-third of the adult value.

Transfund anticipates that no additional analysis will be required of the application of the base values of in-vehicle time for bus and rail passengers. However, it will be made clear that the values presented in the Transfund manuals are for existing users of the services and that the time values of new users attracted from other modes of transport may differ.

The updating requirements for passenger transport users are similar to the requirements for road users. Updating will be based upon major re-surveys of public transport use in the main urban centres, which typically take place at least every ten years.

Reliability and Congestion

We propose to value reliability as an added cost to a perfectly reliable trip, based on user expectations of how much longer a trip would take. It is assumed that users undertake their trip with some idea of the mean (or possibly the statistical mode) of the distribution of travel times. It is also assumed that users make allowance above or below this mean, depending on whether they are risk takers or risk averse.

In principle, it would be possible to measure trip times (whether by car or public transport) over a sample of trips, and then fit a distribution to the travel times. This will be an asymmetric extreme value distribution with upper and lower bounds.

Once information relating the variance of trip times from the mean trip time has been obtained, the application of this information in a practical situation needs to be considered. It is very likely that there will be a positive correlation between congestion and reliability. Extending the sampling of trips to cover periods from good to poor levels of service will enable this relationship to be determined. Where there is a particular traffic improvement project, for example traffic flow across a harbour bridge, the trip sampling should be targeted

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4 Refer Abstract No S.00508 to the IRF World Road Congress in Paris.
at this facility to determine the existing relationship between flow conditions and travel time reliability.

An improvement project may reduce overall congestion, in which case both congestion and reliability improvements will result, or it may influence reliability only (for example, by implementing an improved demand management system). The congestion benefits will be estimated based on link conditions, while the reliability benefits will be based on trip numbers and congestion improvements on the assigned routes.

Congestion will be measured as a factor on travel time. The Stated Preference design will use three levels of congestion, and this will require continuous measures to be distinguished for use in traffic analysis. As the design is intended to cope with urban and rural driving, qualitative descriptions such as level of service (LOS) are appropriate. These are defined in the US Highway Capacity Manual, which forms the basis of New Zealand’s traffic engineering practice.

**Urban Roads**

- LOS A – vehicles are completely unimpeded in their ability to manoeuvre within the traffic stream. Control delay at signalised intersections is minimal. 90% of free flow speed
- LOS B – the ability to manoeuvre within the traffic stream is only slightly restricted, and control delays at signalised intersections are not significant. 70% of free flow speed
- LOS C – ability to manoeuvre and change lanes in mid-block conditions may be more restricted than LOS B, and longer queues, adverse signal co-ordination, or both may contribute to lower average travel speeds of about 50% of the free flow speed for the street class.
- LOS D borders on a range in which small increases in flow may cause substantial increases in delay and decreases in travel speed. 40% of free flow speed.
- LOS E is characterised by significant delays and average travel speeds 33% or less of free flow speed.
- LOS F urban flow at extremely low speeds typically 25-33% of free flow speed. Intersection congestion is likely at critical signalised locations with high delays, high volumes and extensive queuing.

**Rural Roads**

The Australian Austroads guidelines provide rural road LOS descriptions, which are the most relevant for New Zealand rural roads:

- LOS A – a condition of free flow in which drivers are virtually unaffected by the presence of others in the traffic stream. Freedom to select desired speeds is extremely high and the general level of comfort and convenience provided is excellent (< 30% time spent following)
LOS B – in the zone of stable flow and drivers still have reasonable freedom to select their desired speed and to manoeuvre within the traffic stream, although the general level of comfort and convenience is a little less than LOS A (30-45% of time spent following)

LOS C – is also in the zone of stable flow, but most drivers are restricted to some extent in their freedom to select their desired speed and to manoeuvre within the traffic stream. The general level of comfort declines noticeably at this level (45-60% of time spent following)

LOS D – is close to the limit of stable flow and is approaching unstable flow. All drivers are restricted in their freedom to select their desired speed and to manoeuvre within the traffic stream. The general level of comfort and convenience is poor and small increases in traffic flow will generally cause operational problems (60-75% of time spent following)

LOS E – traffic volumes are at or close to capacity, and there is virtually no freedom to select desired speeds or to manoeuvre within the traffic stream. Flow is unstable and minor disturbances will cause breakdown (75-100% of time spent following)

LOS F – zone of forced flow; demand flow exceeds capacity; queuing and delays result (100% of time spent following)

As worded above, the Stated Preference designs are in the range LOS B to E. LOS B is probably closest to the “no congestion” condition but the other end of the range is not as clear.

We anticipate that no additional project analysis will be required to apply the congestion values for road users into the PEM, as congestion values are already applied as factors on the base value of time.

**Passenger Transport**

Congestion for passenger transport users is measured as in-vehicle crowding and seat availability. These can both be observed and modelled, using in-vehicle surveys of boarding and alighting.

For passenger transport users, values for seated or standing passengers are already included in the PEM and congestion values will probably still be applied as a discrete rather than continuous variable. The start of congestion refers to point of boarding, which implies that different values will be applied to passengers on the same bus, depending on where they boarded. This is intuitively reasonable, but adds complexity to public transport modelling, as it will require trips assigned to a passenger transport service to vary in time value according to vehicle passenger loading at the boarding point. If the values are used in behavioural analysis, for example, to test the effects of increasing service frequencies, then potentially it will also add complexity to the assignment process. The value and compliance costs of these changes will be tested before they are implemented.
Ride Quality

Surface quality can be measured using a number of objective measures, such as longitudinal roughness, surface macro-texture and rutting. Visual cues that may correlate with roughness include the extent of patching, trench reinstatements, and crack sealing.

The Stated Preference design measures ride quality as experienced inside the vehicle, based on vibration and jolts. The main issue to be resolved in implementing values will be to map the user experience against objective roughness when filtered through the vehicle suspension, which will vary depending on the vehicle. For example, objective roughness may be hard in a pickup truck and four-wheel drive vehicle, or soft in a hi-spec saloon car. While interior noise is not being included in the design, the user may associate it with the ride quality. The acoustic insulation also varies considerably with vehicle type.

The provision of improved ride quality lies with both the road controlling authority, in providing a smoother road, and the user, in buying a smoother suspension. We therefore have to separate the values to be allocated to each of these two parties.

Values for ride quality will need to be implemented on a link basis, using a factor on travel time. Road roughness is already included as a separate parameter in the PEM vehicle operating cost relationships, so application of a factor for ride quality should not involve very much extra analysis. However, slightly more complexity will be involved in evaluating ride quality for urban networks.

Safety Perception

This Stated Preference exercise characterises perceived safety of the road network by width, roadside hazards, and consistency of geometry. The method of rating these features is outlined below:

- **Width**: carriageway and sealed shoulder width are held in road asset maintenance and management (RAMM) databases on a carriageway segment basis. These are the intermediate segmentation units between treatment length and RAMM road identifiers. Analysis of this data also allows inconsistencies in width to be identified, and Transit New Zealand (which has responsibility for the construction and maintenance of state highways) has already established measurement and performance criteria (target widths) for this characteristic.

- **Roadside Hazards**: rating of roadside hazards is not very advanced at present. Transit New Zealand has recently decided on consistent systems for use over the network. One difficulty is that objects seen by the road user may not be recognised as hazards. Such objects may also carry countervailing values (for example, beautiful trees and rocks as landscape elements), or may be less than obvious (for example, unobtrusive ditches versus steep cliffs). In principle the roadside hazard parameter can be objectively measured.

- **Consistency of Geometry**: rating the consistency of geometry will require a clear specification of the features contributing to consistency and how they should be combined. On a scale of good/moderate/poor, assigning a rating to a section of road is
tractable. Care will be taken to accurately portray this feature to drivers, and to ensure that this portrayal corresponds with the objective measurement.

The Stated Preference design envisages a trade-off between safety and time. The safety values being measured will only apply in an open road environment for two lane roads (the design does not include multi-lanes or issues of median barriers).

The application safety perception values in project evaluations will be more continuous than the good/moderate/poor scale used in the surveys. Thus, it may be necessary to convert these three levels to a continuous function.

An important issue for the application of values for safety perceptions is deciding when a project evaluation should be based on user-perceived safety and when it should be based on crash history or crash rate analysis.