Final Report

TRANSFUND NEW ZEALAND
RESEARCH PROGRAMME 1999-2000

VALUATION OF PUBLIC TRANSPORT ATTRIBUTES

June 2000

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Ref: Z1114/REP/0309

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EXECUTIVE SUMMARY

1. The Project

A research project was commissioned in 1999 to review the values that should be placed on individual components of a public transport journey for use in forecasting the demand for and evaluating the benefits of public transport schemes (new projects and service enhancements). These components include:

- Walking, waiting and in-vehicle time.
- Travel environment factors, such as comfort, cleanliness, safety.
- Other components of user travel costs – mode-specific factors, convenience of transfer, etc.

This report covers Stage A of the project, which involved a review of existing international and New Zealand evidence on the topic, and development of recommendations on appropriate values for use in New Zealand in the absence of other evidence. (Stage B, which has not yet been commissioned, was to involve primary market research in New Zealand).

2. International Evidence Review and Recommendations

The main findings from the review of international evidence are as follows:

- **Walk, wait, in-vehicle and transfer time**. Based on the weight of international evidence, recommended (default) values for use in New Zealand, relative to standard values for seated bus passengers, are as set out in Table 1.

TABLE 1: WALK, WAIT, IN-VEHICLE AND TRANSFER TIMES – RECOMMENDED (DEFAULT) VALUES

Attribute	Value [1]	Notes
In-vehicle time – standing	2.0*V	Valid for 'normal' standing conditions (exclude crush conditions).
Walk time	2.0*V	
Walk time – expected	2.0*V	Needs an associated wait time v headway relationship for modelling purposes.
- unexpected	5.0*V	Needs means of estimating delays and effect on waiting time.
Transfer - to on-street bus	10 mins*V	Apply in addition to all elapsed time.
- to other modes	8 mins *V	

Notes: [1] All values relative to standard value (V) for seated bus passengers.

- **Mode-specific values**. International evidence on the relative passenger attractiveness of different public transport modes relative to on-street bus was summarised and recommendations made on (default) values for use in New Zealand. One issue that needs to be addressed further is the balance between the time-related component and the fixed (per trip) component of these mode-specific valuations.

- **'Soft' variables**. International evidence on passenger valuations of other ('soft') features of public transport modes was appraised, for both bus and rail modes. It covered on-vehicle features (eg. cleanliness, ventilation, driver attributes, passenger information) and off-vehicle features (eg. station facilities, ease of boarding, station/stop information, seats/shelter). Guidance was provided on a likely range of values for each feature. Where feasible and affordable, it is suggested that primary market research be undertaken if 'soft' benefits are a major component in scheme justification.

3. Review of Current New Zealand Evidence

Very little primary market research has been undertaken in New Zealand to establish the valuations of various public transport attributes in the New Zealand context. There is no clear evidence of different valuations in New Zealand from those found internationally. In the absence of significant primary research, it could be expected that the relative values found from international research (in broadly comparable situations) would be sensibly transferable to the New Zealand situation.

4. Future Market Research in New Zealand

The Report makes brief comments on the need for and potential scope of any primary market research in New Zealand, to establish more reliable estimates of component valuations for use in future demand forecasting and evaluation for projects in New Zealand.

ABSTRACT

A research project was undertaken in 1999/2000 to review international evidence on user valuations of the individual components of public transport journeys, for use in forecasting the demand for and evaluating user benefits of public transport improvement projects. These components covered: walking, waiting and in-vehicle time; transfers between services; travel environment factors (eg. comfort, cleanliness, safety); and any mode-specific factors.

Recommendations were made in regard to appropriate valuations for application in New Zealand (in the absence of primary market research in New Zealand); and guidance was given in relation to primary market research needs.

1. INTRODUCTION

1.1 THIS REPORT

This is the final report for Stage A of a project for the Transfund New Zealand Research Programme 1999-2000: Topic Area E – Travel Behaviour (reference 0423). It has been prepared for Transfund by consultants Booz·Allen & Hamilton (New Zealand) Ltd.

The overall project is concerned with the "Valuation of Public Transport Attributes" for use in the demand modelling and economic evaluation of changes to urban public transport services in New Zealand. Stage A is concerned with existing New Zealand and international evidence on the topic. Subsequent stages (not yet commissioned) would involve primary market research in New Zealand to establish improved valuations for application in New Zealand.

1.2 PROJECT BACKGROUND

The traditional values of walking, waiting and in-vehicle travel time used in the evaluation of public transport initiatives were defined by the UK Department of Transport in the 1970s, and have been used with little variation since. Basically these value in-vehicle time (for seated passengers) at a comparable rate to car driver time, and value walking and waiting time at double the in-vehicle time. There are various treatments of transfer time, with most practitioners assuming a transfer penalty in addition to the actual time and cost of transfer.

Recent work on 'soft variables' has attempted to value other aspects of the transport experience – the facilities provided at stations, age and cleanliness of vehicles, etc. Intuitively, these factors could be expected to influence the travel decision and there should therefore be a willingness to pay which would be a component of the consumer surplus. It is often not clear, however, whether these benefits are in addition to those traditionally measured, or whether they are effectively subsumed in the factors used to value waiting and transfer time.

The evaluation of potential new modes (eg light rail) requires consideration also of 'mode-specific factors': such modal factors may substantially increase patronage and contribute a major proportion of the economic benefits of new modes relative to existing services. However, their valuation is an issue of considerable controversy (in New Zealand and internationally).

The values placed on the attributes of a public transport trip can have a significant impact on the estimation of the user benefits. Since the estimated benefits also affect the patronage forecasts, the values will have both a direct and an indirect impact on estimates of the economic viability of any proposed scheme. This will be of concern to the funding authorities (Transfund and the relevant regional council), which are responsible for ensuring appropriate investment decisions are made, and to any operator that is expected to contract for the provision of services based on the patronage forecasts.

1.3 PROJECT OBJECTIVES, PHASING AND OUTPUTS

The **overall objective** of this project was to review the values that should be placed on individual components of a public transport journey for use in forecasting the demand for

and evaluating the benefits of public transport schemes (new projects and service enhancements). These components include:

- Walking, waiting and in-vehicle time.
- Travel environment factors, such as comfort, cleanliness, safety.
- Other components of user travel costs – mode-specific factors, convenience of transfer, etc.

The project was envisaged as involving three main stages:

- Stage A: Review of Existing Evidence
- Stage B: New Zealand Market Research
- Stage C: Conclusions, Peer Review and Reporting.

This report is concerned only with Stage A : Stages B and C have yet to be commissioned.

The overall **output** of this project was to be recommendations on improved valuations for various components of public transport trips, for use in both demand modelling and economic evaluation for urban public transport improvement schemes in New Zealand.

Such valuations should assist funding authorities (principally Transfund and regional councils) and public transport operators involved in the development, evaluation and implementation of such schemes. They should also provide a significant input to Transfund's current major review of transport user benefit parameters.

1.4 REPORT STRUCTURE

The remainder of this report is structured as follows:

- Chapter 2 - sets out an analytical framework for the valuation of the various components of public transport trips, and then presents our summary and assessment of the international evidence for each group of components.
- Chapter 3 - sets out current New Zealand evidence and practice for demand modelling and evaluation purposes.
- Chapter 4 - presents a summary of conclusions and recommendations.

The detailed international evidence is presented in Appendices A – E, each covering a different group of trip components (refer Contents page). Appendix F contains a full list of references.

2. ASSESSMENT OF INTERNATIONAL EVIDENCE

2.1 APPROACH OVERVIEW

This project is essentially concerned with establishing improved user valuations for all components of urban public transport trips, for use in the 'generalised cost' function required for demand modelling and economic evaluation purposes.

In this regard:

- It covers all attributes of trips by public transport (door-to-door), as experienced by the user.
- The appropriate valuations are those based on user behaviour ('willingness-to-pay'), however derived (eg revealed preference or stated preference studies). (In this regard it is consistent with the approach being pursued in the current PEM Benefit Parameters Review).
- It derives all valuations relative to values of in-vehicle time savings in 'standard' conditions (essentially for seated passengers): no attempt is made to establish absolute values of time saving for this standard condition.

The general user 'generalised cost' (GC) function may be expressed as follows:

$$GC = \left[T_A * W_A + T_W * W_W + T_I * W_I + N_T * W_T + T_M + S_M \right] * V + F$$

where:

- V = standard value of (in-vehicle) time ($/min)
- F = fare ($)
- T_A = access/egress time (mins)
- W_A = weighting on access time
- T_W = waiting time (mins)
- W_W = weighting on wait time
- T_I = in-vehicle time (mins)
- W_I = weighting on in-vehicle time
- N_T = number of transfers
- W_T = transfer penalty (equiv mins)
- T_M = mode-specific constant (equiv in-bus mins)
- S_M = aggregate valuation of 'soft' variables (equiv in-bus mins).

The remainder of this chapter is concerned with assessment of the international evidence on valuations for the following components of the GC function:

- Access and waiting time (W_A, W_W) – Section 2.2
- In-vehicle time (W_I) - Section 2.3
- Transfer penalty (W_T) - Section 2.4
- Mode-specific factors (T_M) - Section 2.5
- 'Soft' variables (S_M) - Section 2.6.

2.2 SYSTEM ACCESS ATTRIBUTES

2.2.1 Walking and Waiting – 'Standard' Situations

A substantial number of studies (both RP and SP-based) have established relative valuations between walk time to/from services, (scheduled) wait time for the services, and in-vehicle time. These are summarised in Table A1.

The 'conventional' assumption (as adopted in many demand modelling and evaluation manuals) is that both walk time and wait time are given weightings of 2.0 relative to in-vehicle time. The wait time weighting appears to be derived generally on the assumption that wait time is half the service headway (ie the weighting factor relative to headway itself would be 1.0).

Inspection of the Table A1 results gives the following:

Walking Time (22 results):
Mean 1.95
Min 0.9, max 3.0
16 ex 22 in range 1.5 – 2.5
Relatively low variance, reasonably evenly distributed about mean.

Waiting Time (24 results):
Mean 2.55
Min 0.4, max 6.1
9 ex 24 in range 2.0 – 3.0 (9 also in range 1.5 - 2.5)
Relatively high variance, with several high values (which distort the mean).

Ratio Waiting: Walking Time (18 studies in which both derived):
Waiting < Walking7 studies
Waiting = Walking4 studies
Waiting > Walking7 studies.

Based on these results, we would reason as follows:

- For walking time, we adopt a value of 2.0 : this is very close to the mean of the results, which also have a fairly even distribution about this mean.
- For waiting time, the mean result (2.55) is 0.6 higher than for walking time. However, this mean value is distorted by a number of high values (several over 4.0) : exclusion of the three highest values would reduce the mean to 2.15.
- Also, analysis of the ratios waiting : walking time for studies where both have been determined shows the ratios split evenly between those greater and less than 1.0 (as above).
- Further, we believe that there is danger of the waiting time weights being over-stated in some cases, as they may include an element of 'unexpected' waiting – which we consider separately (below).
- We therefore recommend adoption of the weight of 2.0 for waiting time, as for walking time (and consistent with the 'conventional' assumption).
- This waiting time weight is on the basis that wait time is calculated as half the headway. More generally, for some purposes it may be better expressed as a weighting of 1.0 on headway (service interval). (Thus, in cases where waiting time is estimated at less than half headway, the corresponding waiting time weight would be greater than 2.0).

2.2.2 Walking and Waiting – 'Non-standard' Situations

Here we refer to situations of other than 'standard' walking to/from a service or waiting for the service. These include:

- Queuing (for tickets, to board vehicle, etc)
- Travelling on lifts or escalators.

We have only identified one study that addresses such situations – a 1996 review of evidence and practice by London Transport (refer Table A2).

Given this limited evidence and the low occurrence of such situations in New Zealand, we do not make any recommendations on appropriate values for these situations.

2.2.3 'Unexpected' Waiting Time

This arises when services are delayed relative to their scheduled time. The evidence is summarised in Table A3: it is perhaps surprising that there is not more evidence on this important issue of service reliability.

The weight of evidence was assessed in a 1997 BAH review: this concluded that unexpected waiting time is valued at 2-3 times ordinary waiting time.

Based on this and our earlier conclusion for ordinary waiting time, we recommend that unexpected waiting time be given a weight of 5.0 (relative to in-vehicle time).

In practical application to derive the disutility of waiting for an (unreliable) service:

- **Either**, the disutility is calculated separately for the expected waiting time and the unexpected waiting time (with appropriate weights);
- **Or,** an averaged wait time v headway relationship and an averaged weighting on all wait time is calculated, based on evidence on the level of reliability of the service.

The role of real-time information in reducing the perceived weighting on unexpected waiting time should be noted here, although no quantification of this is attempted.

2.3 IN-VEHICLE ATTRIBUTES

The 'standard' value of in-vehicle time relates to situations where passengers can get a seat and travel in reasonably uncrowded conditions. Here we are concerned with in-vehicle travel where these assumptions do not apply, ie in situations where seats are not available and conditions may be congested.

The available evidence is summarised is Table B1. Again, there are surprisingly few studies that have attempted to quantify this important aspect.

The 'conventional' assumption (including in PEM) for standing passengers is to adopt a weight of 2.0 (relative to seated passengers). From the limited evidence, we see no grounds for varying that assumption.

We suggest that assumption is reasonably valid for standing for up to 15-20 minutes when not in excessively crowded ('crush') conditions: this would cover most 'standing' situations encountered in New Zealand. If situations are encountered outside this range, we suggest that specific consideration be given.

2.4 TRANSFER PENALTIES

2.4.1 Introduction

This section summarises international evidence on the valuations that public transport users put on the 'inconvenience' of transfers between urban public transport modes. These 'inconvenience' disbenefits reflect user behaviour and perceptions relating to the quality, reliability etc of the transfer experience, independent of any walking and waiting time involved in the transfer. They are therefore appropriate for use in behavioural modelling and economic evaluation.

The valuations have been expressed in terms of 'equivalent in-vehicle time', to maximise comparability across countries and situations.

There is a clear consensus that time spent transferring is more onerous than in-vehicle travel time, and than other forms of out-of-vehicle time:

> *"The theoretical rationale for travelers' higher valuation of waiting time is that such time is difficult for passengers to employ productively, is often spent in an unprotected environment, and… is typically of uncertain duration, even where the schedule of service is known in advance."* (Charles River Associates, 1989)

Clearly the 'inconvenience' associated with transferring will depend on the 'quality' of the transfer experience, in terms of service coordination/uncertainty, weather protection, climatic conditions etc. A considerable range of values for transfer penalties would therefore be expected in practice.

2.4.2. Summary of Findings and Commentary

The results of the review of international evidence are summarised in Appendix C and in particular in the two tables presented there:

- Table C1 – evidence on the valuation of transfer penalties for urban public transport travel
- Table C2 – evidence on factors which affect user valuations of transfer penalties.

The Table C1 values have generally been derived from the calibration of transit mode/ route models. As expected, a considerable range of values is found.

The Charles River Associates (1989) reference provides perhaps the leading review of international evidence, deriving values from USA/Canada, Europe and Asia, in terms of equivalent in-vehicle (IVTT) or out-of-vehicle travel time (OVTT). It concludes that:

> *"There is a strong central tendency for the transfer penalty to equal 6 to 10 minutes of out-of-vehicle travel time"*. [Applying a factor of 2.0, this is equivalent to 12-20 minutes IVTT.]
>
> *"The bus to rail transfer penalties are less than the bus to bus penalties…"*
>
> *"Work/peak period travellers value the transfer penalties somewhat higher than non-work travellers".*

The findings from other key sources may be summarised as follows:

- **British Rail** (1989). Recommends value of 10-14 mins IVTT for shorter distance (up to 15 kms) trips, for transfers between rail-based (BR/Underground) services. Also notes observed value of about 5 mins IVTT from BR/Underground route choice observations for shorter trips.
- **London Transport** (Ryan 1996). Recommends values of 3.5 mins for Underground-Underground transfers, 5.0 mins for Underground-BR transfers.
- **Netherlands** (Van de Waard, 1988). Found values ranging from 4.2 mins to 9.2 mins IVTT (average 5.7 mins) for transfers between modes/routes in major Netherlands' cities.
- **Perth** (Piotrowski, 1993). Before/after survey of the Northern Suburbs Railway system found values of 8-9 mins IVTT for bus-bus transfers, 6 mins for bus-rail transfers. This study is perhaps particularly relevant to other Australasian conditions: it involved a Stated Preference survey, of high quality with substantial sample size, and found considerable consistency of response before and after opening of the Railway.

The evidence on the key factors that appear to affect transfer penalties may be summarised as follows:

- **Transit modes.** The mode to which the transfer is being made appears to be a key factor affecting the size of the transfer penalty. Penalties are generally lowest between enclosed rail services (eg metros), highest for transfers between bus services. The penalties are clearly affected by the 'quality' of the transfer, service reliability etc (see below).
- **Trip purpose.** Work travellers generally have higher penalties than non-work/leisure travellers.
- **Trip length.** Transfer penalties appear to increase with increasing travel time (IVTT).
- **Transfer 'quality'.** The physical quality of the transfer will affect valuations (eg weather protection, particularly in extreme climatic conditions; need to negotiate steps). The reliability of the service being transferred to may also have a substantial effect (not captured elsewhere in the model calibration).

2.4.3 Conclusions

It is apparent from the foregoing that transfer penalties appear to vary over a considerable range, in large measure because of the wide range and quality of transfer situations encountered.

The findings/recommendations from the main sources reviewed may be summarised as follows:

- Charles River Associates: recommends 15-25 mins IVTT (in context of Houston metro and bus feeder services).
- British Rail (NSE): recommends 10-14 mins IVTT for medium-distance urban trips (but notes value of 5 mins IVTT observed for shorter-distance NSE/LUL route choice).
- London Transport: recommends 3.5 mins for LUL/LUL transfers, 5.0 mins for LUL/NSE transfers.
- Netherlands: finds average value 5.7 mins IVTT (range 4.2 - 9.2 mins, according to interchange quality and conditions).

- Perth: finds c.6 mins IVTT for bus/rail transfers, c.8-9 mins for bus/bus transfers.

As noted above, the Perth values may be perhaps taken as reasonably representative of typical Australasian conditions. They are also towards the middle of the range of values found (or recommended) in the main sources. As found in Perth, the weight of evidence would suggest that values for transfers to rail are lower than for transfers to bus.

For modelling and evaluation in the New Zealand urban context, we recommend adoption of the following values:

- Transfer to on-street bus: 10 mins IVTT
- Transfer to other (fixed track) modes: 8 mins IVTT.

(In each case, IVTT relates to the value of time selected for on-street bus mode.)

In cases where transfers are a substantial issue, we would also recommend sensitivity testing about these 'most likely' values (say ± 50%).

2.5 MODE-SPECIFIC FACTORS

2.5.1 Introduction

The relative 'attractiveness' to users of public transport services by different modes will depend on a number of factors, principally:

- Total travel time (including walk time, wait time, in-vehicle time) – refer Sections 2.2, 2.3.
- Numbers of transfers (and perceived quality of these transfers) – refer Section 2.4.
- Other factors associated with the mode which are not so readily quantified, eg quality of stations, service reliability, in-vehicle comfort, 'image', etc.

In formulating a 'generalised cost' function for different trips, this last group of factors are often lumped together and given the name mode-specific factors or **mode-specific constant** (MSC). The MSC largely reflects the intrinsic features of the mode: traditionally all trips by a given mode are attributed the single MSC value associated with that mode (although this approach is open to question – see following discussion).

Experience in previous evaluations is that a large proportion (sometimes over 50%) of the estimated user benefits from introducing 'new' public transport modes (eg an LRT system in preference to an on-street bus system) arise from the postulated change in MSC. Thus the estimation of MSC values is a critical component of the evaluation of such projects.

This section therefore summarises and draws conclusions from international evidence on:

- Actual behaviour following the introduction of new public transport modes in urban areas, and it implications for MSC values.
- Stated intentions towards use of new systems not yet introduced, from SP surveys.
- How actual usage (RP data) compares with stated intentions (SP data) from 'before and after' studies of new/improved public transport systems.

The evidence from each of the sources examined is presented in full in Appendix D. The following sections summarise our findings.

2.5.2 Evidence On Actual Behaviour And Valuations

The evidence from actual behaviour (RP data) on the relative MSC values for different PT modes is somewhat limited. It may be divided into two main types of evidence:

- From situations where travellers have the choice of two or more PT modes for their trip. This is the most reliable situation for assessing preferences, as modal choice behaviour may be examined directly.
- From situations where one mode has replaced another, and preferences have to be deduced from changes in behaviour and patronage ,using before and after surveys.

Mode Choice Situations

The studies undertaken by **Halcrow Fox** (Appendix D2.1) after the opening of the Manchester Metrolink found that:

- Travellers with a car available had an MSC for Metrolink (LRT) over on-street bus equivalent to around 20 in-vehicle minutes; while for travellers without a car available the MSC difference appeared not significantly different from zero.
- For the existing heavy rail services, the MSC relative to on-street bus was negative, reflecting perceptions of poor reliability and security of the rail services.

Fouracre (Appendix D2.3) notes that the MSC for rail-based modes is typically 4-6 minutes better than for on-street bus travel.

Van der Waard (Appendix D2.4) found in Netherlands that:

- VTTS for on-street trams is equal to that of on-street buses.
- VTTS for segregated modes (suburban rail, metro, segregated trams) is about 10% lower than for on-street modes (bus or tram). For a typical journey this would equate to an MSC difference of around 2-3 in-vehicle minutes.

Before and After Evidence

The **Adelaide O-Bahn** has resulted in an increase in PT patronage of around 45% in the corridor concerned (Appendix D2.2). Only about one-third of this can be attributed to the travel time savings, implying that other factors, covered by the MSC, have accounted for a patronage increase of around 30%. Conventional elasticity assessment would suggest this is equivalent to a further reduction in perceived in-vehicle time of about 20 minutes, ie. the MSC for O-Bahn relative to on-street bus is equivalent to 20 minutes IVTT.

Comments

The two groups of results above produce differing conclusions:

- The evidence from the mode choice situations suggests MSC values for rail-based modes relative to on-street bus in the range 2-6 in-vehicle minutes.
- The O-Bahn before/after evidence suggests an MSC value for O-Bahn relative to on-street bus in the order of 20 in-vehicle minutes.

2.5.3 Evidence On Stated Intentions

There is now considerable evidence from SP surveys, principally in UK, on stated intentions to use new modes proposed for urban areas. We comment on the evidence in two groups:

- UK/Ireland evidence
- Australia (Canberra) evidence.

UK/Ireland Evidence

Kilvington (Appendix D3.1) summarised the results from 10 UK SP studies. He found that MSC values for **car users**, relative to on-street bus, averaged (in in-vehicle minutes):

- Guided Bus 8.5 mins
- Heavy Rail 11.5 mins
- Light Rail 14.5 mins.

In Dublin, Kilvington (Appendix D3.2) reported that car users were indifferent between heavy rail and light rail, valuing both these at 11 in-vehicle minutes superior to guided bus. However, current bus users valued light and heavy rail only 4 in-vehicle minutes superior to guided bus, which was in turn 12 in-vehicle minutes superior to on-street bus.

The tentative conclusions from this SP evidence are that relative valuations are:

- Guided Bus: 8-12 mins IVTT superior to on-street bus
- Light and Heavy Rail: about equal to each other
  3-6 mins IVTT superior to Guided Bus
  (ie. 11-18 mins IVTT superior to on-street bus).

A review of UK SP surveys as part of the London Railplan studies (Appendix D3.3) found that:

- Bus on-street users preferred other modes (guided bus, light rail, heavy rail) by about 8 minutes in-vehicle time in each case.
- Car users rated light rail as some 8 in-vehicle minutes better than both guided bus and heavy rail.

Australian Evidence

The Canberra SP survey (Appendix D3.4) indicated very little difference between LRT, Busway and O-Bahn in terms of people's perceptions and likely responses. Car users marginally preferred LRT to Busway and O-Bahn; while bus users marginally preferred Busway to LRT and O-Bahn.

These results may be explained by Canberra already having a relatively good bus service, little affected by traffic congestion.

2.5.4 Actual Behaviour Compared To Stated Intentions

Two USA studies were reviewed where SP surveys have been undertaken before the introduction of a new mode, RP surveys have been undertaken following introduction, and the results of the two surveys have been compared (Appendix D4.1, D4.2). In each case the conclusions are similar:

"Actual behaviour can be predicted from behavioural intent by dividing behavioural intent by a number between 3 and 5",

ie. SP surveys of use of a new mode are likely to over-predict actual use by a factor of three to five times.

One New Zealand market research survey (Appendix D4.3) also found similar over-statement problems, when comparing the results of an SP survey with expected changes in bus usage based on 'standard' fares and service elasticities.

The implication of these results is, that when offered the choice of new PT modes, current non-PT users are likely to substantially over-state their likely use of these modes; and hence, by implication, their MSC values of these new modes relative to car (and probably to on-street bus).

2.5.5 Conclusions and Recommendations

The findings from this review of international evidence on the relative MSC values of different PT modes are not all consistent. Our main findings are as follows:

i SP evidence from European surveys, principally of car users, suggests that:

- Guided Bus: MSC 8-12 minutes IVTT superior to on-street bus
- Light/Heavy Rail: MSC values similar to each other, 3-6 minutes superior to Guided Bus (ie. 11-18 minutes superior to on-street bus).

ii SP evidence from Canberra suggests less difference between LRT, Busway and Guided Bus in situations where there is already a relatively good bus service.

iii 'Before and After' comparisons of actual (RP) and stated (SP) behaviour indicate that SP surveys tend to over-state the use of new modes by existing car users by a factor of 3-5; and hence to over-state MSC values for new modes relative to car and on-street bus.

iv RP evidence generally indicates MSC values for rail-based modes in the order of 5 minutes IVTT superior to on-street bus.

v However, the Manchester Metrolink (LRT) studies indicate a preference for LRT over on-street bus of around 20 minutes IVTT for people with a car available, but close to zero for people without a car available.

vi The Adelaide O-Bahn patronage figures (relative to the previous on-street bus) suggest that its MSC value is in the order of 20 minutes IVTT superior to on-street bus.

Based on these findings, Table 2.1 sets out our 'default' best estimates for MSC values for use in New Zealand urban public transport modelling and project evaluation.

In deriving these recommended values, we have taken note of the Halcrow Fox comments, in particular the following (which confirm our own views):

- *"The lesson from a lot of the work we have examined or carried out is that its often worth substituting judgement for erroneous SP parameters".*
- *"The most appropriate assumption would seem to be that 50% (of the MSC) was a constant effect and the remaining 50% related to distance".*

The recommended values have been set based on:

- A typical LRT trip would have a total MSC preference over on-street bus of around 10 in-vehicle minutes (additional to any effects relating to walk/wait time, in-vehicle time etc).
- Approximately half this effect would be in the constant term (relating to factors independent of trip length, such as service reliability, station 'image' etc), and half in the factor applied to in-vehicle time (relating to factors such as ride quality, seat comfort etc). However, it is recognised that this 50:50 split is somewhat uncertain.

TABLE 2.1: MSC VALUES RECOMMENDED FOR URBAN PUBLIC TRANSPORT MODELLING AND PROJECT EVALUATION

Mode	MSC Function		Notes
	Constant (In-Bus Mins)	Variable (Factor on In-Vehicle Time)	
On-Street Bus	0	1.0	
DMU	2.5	0.9	Existing DMU. New DMU may be more comparable to LRT.
Busway (Unguided)	2.5	0.9	
LRT	5	0.8	Equivalent to about 10 in-bus minutes difference for typical trip (25 min in-bus)

2.6 'SOFT' VARIABLES

2.6.1 Introduction

Service quality plays an important role in determining the overall attractiveness of a public transport service. Over the past 20 years, a significant number of major studies have attempted to quantify the value of individual service quality attributes in terms of their impact on public transport users. This section summarises the available evidence on the values users place on service quality, in terms of factors such as cleanliness, reliability, security, and comfort.

A substantial number of studies were reviewed but only those studies that provide results in terms of monetary value, in-vehicle time or proportion of fare are reported. The results of studies that used a qualitative assessment process or simply ranked alternative options were not considered to be transferable to different markets. It is noted, however, that all valuations are likely to vary according to the details of a particular situation and therefore it is generally best to undertake primary research where possible.

The detailed results from the individual studies are given in Appendix E. The following paragraphs provide a overview of these results and develop recommendations.

2.6.2 Rail Services – International Evidence

Overview

The most comprehensive recent studies into the impact of 'soft variables' on rail passengers are those completed for CityRail, Sydney (Douglas 1995) and London Underground, UK (London Transport 1997).

Both studies used extensive consumer surveys to determine the impact of factors such as:

- Ticketing facilities
- Station environment
- Station access
- Station facilities
- Platform features
- Station staff
- Customer information
- Train environment and facilities
- Train staff and security.

The detailed results of these studies are presented in Appendix E along with the result of a number of other studies including MVA (1985), Copley (1988), Accent Consultancy (1993) and Steer Davies Gleave (1990).

The earlier studies (e.g. MVA (1985) and Copley (1988)) generally produce significantly higher estimates of the value of service quality attributes relative to the more recent work. Current literature on the topic generally accepts that the earlier studies over-estimated the passenger value of service quality attributes by failing to take into account revealed preference data and to scale the results accordingly.

The London Underground study values reflect an access time of 1 minute and platform wait time of 3.85 minutes. These access and wait times are lower than the average access and wait times experienced at most Australian railway stations. This may, in part, explain why Douglas (1995) typically produces higher values than London Transport (1997) in terms of parameters related to the station environment. The results are however, within a similar range (i.e. typically less than 0.5 minutes per improvement).

The service quality valuations are presented in one of two ways:

- Estimates which provide a valuation on a 'with and without basis' (e.g. presence of a waiting room, seating, platform surveillance camera); and
- Estimates which essentially provide a relative valuation of facilities being provided to a high standard as opposed to a poor standard (e.g. cleanliness, state of repair etc).

The results typically indicate that the value of any individual improvement is generally less than one minute of in-vehicle time. If a number of improvements are summed together, however, the impact can be significant. In an extreme case, consistent with all the improvements occurring at once, the estimated valuation would be very significant and possibly exaggerated (i.e. the so-called 'packaging problem'). To mitigate this problem, the research completed for London Underground (1997) attempted to establish a value not only for individual service quality attributes but also a valuation consistent with moving from the

'existing service' to the 'perfect service'. The valuation of the perfect service effectively provided a maximum valuation, or 'cap', on the benefits attributable to improvements in service quality.

As an extension of this theme, Jones (1998) recommends that valuations for a range of packages be established, rather than simply focussing on the valuation of the perfect service.

Summary / Recommendations
The available evidence suggests that soft variables have positive but modest values in terms of in-vehicle time. For some improvements, these values may not be significantly different from zero.

In the absence of primary research, Douglas (1995) is the most applicable research for Australasian circumstances. The results provide an indication of the likely impact of a wide range of improvements to rail facilities and are in keeping with evidence from comparable studies conducted internationally.

2.6.3 Rail Services – New Zealand Evidence

In 1997, Booz·Allen & Hamilton carried out a survey of rail passengers at Porirua Station, to assess their valuation of the benefits of the recent station upgrade and their views on the relative benefits of different features of the upgrade (Booz·Allen & Hamilton, 1998). From this stated preference survey, valuations of the different upgrade features were estimated, as set out in Table 2.2.

TABLE: 2.2 : PORIRUA STATION UPGRADING – USER VALUATION OF UPGRADE FEATURES ([1]).

Feature	Average Valuation – c per day
Improved Waiting Area	9.3
Security Cameras in Station	8.2
New Ticket Kiosk	7.6
New Seats	7.6
New Toilets	6.5
New Information Boards	4.8
Total	44.0

Notes: ([1]) From Booz·Allen & Hamilton (1998). "User Survey: Valuation of Benefits of Upgraded Porirua Railway Station". Report to Wellington Regional Council and Transfund New Zealand, January 1998.

In interpreting these results, the following should be noted:

- Values may be compared with a typical value of travel time savings for public transport passengers in the order of 8-10c/minute.

- These values are per day, and typically therefore relate to a return trip. However, the benefits predominantly relate to the outbound trip (ie. from Porirua), as no waiting at the station is involved on the inbound trip.

- These values are averaged over peak and off-peak users. On average valuations for off-peak users were about 25%-30% higher than for peak users. This could well be explained by the longer waiting times in off-peak periods.

- The values for the individual features should be regarded as approximate only, as they were inferred from the total package value and respondent views on the relative benefits associated with the individual features.

- The results are clearly specific to the particular set of improvements undertaken at Porirua Station, and hence are not directly transferable to different situations.

Despite these results, a reasonable measure of agreement was found between the Porirua values and values from international evidence:

- The total perceived value of the package (44c/day on average) was close to the value predicted in the 'before' evaluation (41c/day).

- The value of the individual features are generally in the range 0.5 - 1.0 in-vehicle minutes. These are somewhat greater than the weight of recent international evidence. They are perhaps more consistent with the earlier UK studies (referred to above), but may in part reflect the initial poor condition of the station.

2.6.4 Bus Services

Overview of Evidence

The study conducted by Steer Davies Gleave (1997) for London Transport is the only readily available research that provides a comprehensive range of service quality valuations for bus travel. The study included a large-scale user stated preference survey to generate monetary valuations with respect to:

- Pre-trip information
- Bus stop infrastructure (i.e. bus shelters, seating, lighting)
- Information at bus stop (i.e. printed and real time information)
- Boarding the bus (i.e. vehicle stops close to kerb, steps vs low floor)
- Driver (i.e. exact fare vs change, driver appearance and attitude)
- Moving to seat (i.e. luggage area vs standing room, forward facing seats etc)
- Travelling (i.e. ventilation, cleanliness)
- Leaving the bus (i.e. information regarding the next stop, number of doors).

The original estimates of the benefits associated with each improvement were presented in monetary units and these estimates were converted to minutes of in-vehicle time using the behavioural value of time recommended by London Transport (1997). It is noted, however, that the value of time derived from the bus users that were actually surveyed to produce the results was significantly lower than this. The rationale for using the higher value of time estimate is that the demographic profile of the users surveyed may have been biased towards pensioners and other low income earners.

The results of this study are included in Appendix E. Note that a 'cap' of approximately 60% of average fare is also applicable when summing the valuation of a number of improvements. This reflects the valuation of the 'perfect service' established by the study.

Recommendations and Conclusions

The available evidence suggests that improvements in bus service quality also result in small positive values in terms of in-vehicle time. However, due to the limited number of studies that have been undertaken, combined with the uncertainty over the value of time that is applicable to the key London Underground (1997) study, the applicability of these results to the Australasian market is unclear.

2.6.5 Summary

Table 2.3 summarises the perceived value placed on various soft variables by bus and train travellers. The results are presented in terms of in-vehicle time minutes, rather than as monetary values or as a percentage of fare, to facilitate easy comparison between surveys.

The variability of soft variables makes it very difficult to produce results that are directly transferable from one service or city to another. For example, the value placed on improved security is likely to be higher in an area that is perceived to have a high crime rate than in an area that is perceived to have a low crime rate. For this reason a range of values are provided for each attribute. Where possible primary research should be undertaken, particularly in situations where a range of alternative options is being considered.

TABLE 2.3 : SUMMARY OF 'SOFT VARIABLE' INTERNATIONAL EVIDENCE(1)

Mode	Attribute	Valuation – in-vehicle mins
Train		
On-train	Train Environment	0.3 to 1.5
	Train Facilities	0.4 to 1.5
	Customer Information	0.3 to 1.1
	Train Staff & Security	1.6 to 2.0
Off-Train	Station Environment	0.2 to 0.5
	Station Access	0.1 to 0.2
	Station Facilities	0.1 to 0.4
	Platform Features	0.1 to 0.4
	Station Staff & Security	0.2 to 0.7
	Customer Information and Ticketing	0.1 to 0.4
Bus		
On-Bus	Driver Attributes	0.3 to 0.7
	Seating	0.2 to 0.4
	Customer Information	0.7
	Bus Environment(2)	-1.5 to 0.5
Off-Bus	Customer Information (at Home)	0.4 to 1.0
	Customer Information (at Bus Stop)	1.5 to 1.7
	Bus Stop Infrastructure	0.2 to 1.0
	Bus Boarding	0.3 to 1.0

Notes: (1). For further details refer to Appendix E.
(2). Negative values reflect attributes such as a dirty bus and poor ventilation.

3. NEW ZEALAND EVIDENCE AND PRACTICE

3.1 CURRENT PEM PRACTICE

Table 3.1 sets out the unit values of time specified for bus passengers in Transfund's current Project Evaluation Manual (PEM). Features worthy of note include:

- For other (non-work) trip purposes, the value of standing time is approximately twice that for seated time, consistent with the evidence summarised earlier (Section 2.3).
- For work trip purposes, the standing time value is equal to the seated value (based on average wage rates). Thus no allowance is made for the personal disutility of having to stand (ie the approach taken between working and non-working time is inconsistent).
- For all purposes, an additional value applies in congested conditions. The case for applying this to bus passengers is somewhat unclear: it may be a proxy for the uncertainty in travel times often associated with congested conditions, as the driver stress factor for congested conditions is not applicable to bus passengers.
- Only in-vehicle times are given in PEM (and the associated ATR Manual). We assume (but it is not stated) that the Pedestrian/Cyclist values are to be applied for walking time and waiting time for public transport passengers: these are identical to the standing values given in the table.

It is also notable that the PEM values for public transport only cover bus passengers: there are no values for rail passengers or for users of other public transport modes.

TABLE 3.1 : TRANSFUND PROJECT EVALUATION MANUAL UNIT VALUES (Bus Passengers)(1)

Travel Purpose	Value of Time - $/Person Hour (July 98)		
	Seated (base)	Standing (base)	Addition for Congested Conditions(2)
In work	21.30	21.30	Up to 2.60
Other purposes	5.25	10.55	Up to 2.60

Notes: (1) Taken from PEM Table A4.1. Also repeated in Transfund 'Alternatives to Roading' Manual

(2) Values additional to base seated/standing values. Additional values applied in congested situations, varying from zero (V/C = 0.70) up to $2.60/hour (V/C = 1.00).

3.2 URBAN TRANSPORT MODELS – EVIDENCE AND PRACTICE

The regional transport models for Auckland and Wellington are the only ones that include public transport within a multi-modal framework. The following provides brief comment on the valuation of public transport attributes and the basis thereof in each of these models.

3.2.1 Auckland Regional Model

Table 3.2 provides a summary of the relevant assumptions and their basis contained in the Auckland Regional Transport (ART) Model. All values have been largely externally derived, although Auckland evidence was used as input to deriving the mode-specific functions.

3.2.2 Wellington Regional Model

Table 3.3 provides a summary of the relevant assumptions and their basis contained in the WRC Regional Transport Model. All parameters/assumptions have been derived from 'external' sources, except for the relative in-vehicle time (train: bus). The value for train has been estimated at 70% of that for bus, based on calibrations of train:bus mode split behaviour in areas where passengers have a choice between these modes. This relativity has been taken to represent the full mode-specific differences (ie no separate mode-specific constant has been included).

TABLE 3.2 : AUCKLAND REGIONAL TRANSPORT MODEL – PUBLIC TRANSPORT GENERALISED COST FUNCTIONS

Attribute	Value	Notes
A. In-vehicle time - bus	$6.53/hour	Same in peak and interpeak models. Weighted average of PEM values for work and non-work trip purposes.
B. Wait time function C. Walk time D. Wait time	0.50* headway 2.0*(A)	Subject to 15 mins maximum. 'Conventional' assumption for walk and wait time.
E. Transfer penalty	8 mins IVTT	Value $0.87 (ie $6.53/60*8). Applies to all transfers between public transport services. Based primarily on Perth experience.
F. Mode-specific functions (relative to on-street bus) F1. Value of time factor: DMU/Busway LRT F2. Constant: DMU/Busway LRT	 0.9*(A) 0.8*(A) -2.5 mins IVTT -5.0 mins IVTT	Based on review of international evidence (RP and SP), consistent with Table 2.1 recommendations. Mode-specific effects taken as approx 50% variable (with time), 50% constant.

TABLE 3.3 : WELLINGTON REGIONAL TRANSPORT MODEL – PUBLIC TRANSPORT GENERALISED COST FUNCTIONS

Attribute	Value	Notes
A. In-vehicle time - bus	$8.20/hour	As for car. Weighted average value (car/PT) derived from PEM values.
B. Wait time function C. Walk time D. Wait time	0.185*headway 2.0*(A)	As used in West Yorkshire Transportation Studies 'Conventional' assumption for walk and wait time.
E. Transfer penalty	8 mins IVTT	Value $1.09 (ie $8.20/60*8). Applies to all transfers between PT services Based primarily on Perth experience.
F. In-vehicle time - train	0.7*(A)	70% of bus IVTT value. Factor based on bus v rail calibration exercises. Factor taken as embracing all PT mode-specific differences.

4. CONCLUSIONS AND RECOMMENDATIONS

This Stage A report has reviewed international (and New Zealand) evidence on the 'Valuation of Public Transport Attributes', for use in the demand modelling and economic evaluation of changes to urban public transport services in New Zealand.

4.1 INTERNATIONAL EVIDENCE

The main findings from the review of international evidence (Chapter 2) are as follows:

- **Walk, wait, in-vehicle and transfer time.** Recommended (default) values, relative to standard values for seated bus passengers, are as set out in Table 4.1.
- **Mode-specific values.** Recommended (default) values reflecting the passenger attractiveness of different public transport modes relative to on-street bus are as given in Table 2.1. In applying these, one issue is whether the mode-specific factors should be split broadly 50:50 between the time-related component and the fixed component (as in Table 2.1); or whether a larger proportion should be taken as time-related.
- **'Soft' variables.** Table 2.3 gives guidelines on appropriate valuations of 'soft' variables for urban bus and train services. No single recommended (default) value is provided, given the range of situations which may be encountered. Where feasible and affordable, it is suggested that primary market research be undertaken if 'soft' benefits are a major component in scheme justification.

TABLE 4.1 : WALK, WAIT, IN-VEHICLE AND TRANSFER TIMES – RECOMMENDED (DEFAULT) VALUES

Attribute	Value(1)	Notes
In-vehicle time- standing	2.0*V	Valid for 'normal' standing conditions (exclude crush conditions)
Walk time	2.0*V	
Wait time- expected	2.0*V	Needs an associated wait time v headway relationship for modelling purposes
- unexpected	5.0*V	Needs means of estimating delays and effect on waiting time.
Transfer - to on-street bus	10 mins*V	Apply in addition to all elapsed time.
- to other modes	8 mins*V	

Note: (1) All values relative to standard value (V) for seated bus passengers.

4.2 NEW ZEALAND EVIDENCE

As noted in Chapter 3, there is very little behavioural evidence on the valuations of various public transport attributes in the New Zealand context. There is no evidence of different valuations in New Zealand from those found internationally. It would be expected that the relative values found from international research (in broadly comparable situations) would be sensibly transferable to the New Zealand situation.

4.3 NEXT STEPS

It now needs to be decided if primary market research should be undertaken in New Zealand to derive values for some of the attributes of interest. If such research is to be pursued, key issues to address will include:

- Which attributes are of most interest?
- Are there appropriate trade-off situations amenable to revealed preference (RP) analysis, or should research focus entirely on stated preference (SP) methods?
- Which city/cities?

APPENDIX A : SYSTEM ACCESS ATTRIBUTES

This Appendix provides the detailed evidence from the sources identified on user valuations of system access/egress attributes, principally:

- Walking – to and from the station/stop (and in transferring between services).
- Waiting (normal situations) – at station/stop.
- Unexpected waiting – relating to service delays.

This evidence is presented in the following three tables:

- Table A1 : Walking and waiting time valuations – 'standard' situations.
- Table A2 : Walking and waiting time valuations – 'non-standard' situations (eg using escalators, stairs or lifts).
- Table A3 : Unexpected waiting – relating to service delays.

In all cases, valuations are expressed as unit value of time savings relative to base values of time savings for in-vehicle (seated) travel on the relevant mode (usually bus or metro).

In regard to these tables, it should also be noted that:

- Valuations are pre-fixed by 'A' for access time (walking), 'W' for waiting time.
- Full source references are given in Appendix F.

TABLE A1 : SYSTEM ACCESS (WALKING AND WAITING) TIMES - STANDARD SITUATIONS : DETAILED EVIDENCE

Reference	City	Basis of Valuation	Mode	Trip Characteristics	Valuations (factors on IVT)	Importance of Source	Additional Comments
MVA et al, 1987	North Kent, UK	RP studies re mode choices	Coach	Coach commuters to Central London	W: 2.5		Full time employees had values c.30% higher
		SP studies re mode choice	Coach		W: 0.7 (dubious?)		
	West Yorks, UK	RP and TP re mode choice	Bus, rail (v car) Urban bus	Commuters	W: 1.3	**	
	Oxford/Leeds, UK	SP, re choice of service	Urban bus, coach, rail	Local bus (private) travel	W: 4.6		
	Various, UK	SP and RP studies		Mostly commuters	A: 2.0	*	Assumed ('conventional') value – survey evidence not clear. Retired people – relatively higher values.
TRRL 1980, quoting following studies:							
Algers et al	Sweden				W:3.5		
Daly & Zachary	7 cities, UK				A: 0.9, W: 3.5		
Gaudry	Montreal, Can				W: 6.1		High value may reflect weather conditions
Hensher	Australia				W: 2.0		
Merlin & Barbier	France				A: 1.75, W: 3.0		
Quarmby	UK				A/W: 2.0 – 3.0		
Richards & Ben Akiva	Netherlands				A: 2.0		
Rogers et al	4 cities, UK				A: 2.5-3.5, W: 1.6-3.6		
SIGMO	Netherlands				A: 2.2, W: 1.3		
Train & McFadden	California, US				A: 1.4, W: 8-11		
Institute of Transport Economics 1993	4 cities, Norway	SP surveys, local bus travel	Bus		Oslo: A: 2.0, W: 1.8 Tromso: A: 1.7, W: 0.4 Trondheim: A: 2.0, W: 0.9 Kristiansand: : W: 0.9	**	Waiting time assumed as half headway.
Barton Aschman, 1981	Houston, US	Mode choice model analyses, based on RP data.		Commuter Other	W: 1.0 – initial wait time W: 1.5 – transfer wait time W: 2.6 – all wait time	*	
	USA (general)	Various modelling studies			A/W: 2.0-2.5	**	
Ramjerdi, 1993	Oslo, Norway	Disaggregate mode choice models	Urban PT	Commuters Other (private)	A: 1.4, W: 2.3 A: 2.0, W: 5.0	*	

TABLE A1 : SYSTEM ACCESS (WALKING AND WAITING) TIMES - STANDARD SITUATIONS : DETAILED EVIDENCE

Reference	City	Basis of Valuation	Mode	Trip Characteristics	Valuations (factors on IVT)	Importance of Source	Additional Comments
HCG, 1990	Netherlands	SP surveys – trade offs walking, service frequency, interchange time and delays	Bus, tram, train	Commuter, business, other	W: c.2.0 (bus/tram). A: c.1.3 (under age 50) c.3.0 (over age 50)	** *	Assumes wait time = half headway. Somewhat lower value for train.
Smith and Milthorpe 1995	Sydney, Australia	'Expert advice' for use in travel modelling	Urban PT	All	A: 2.0,W: 2.5		A value as advised by Hensher; W value by assertion/judgement.
Gwilliam, 1999	General	Judgement based on review of international evidence		All	A/W: 1.5		World Bank recommended values for project evaluation in absence of better local evidence.
Halcrow Fox 1995	Manchester UK	Household interview RP survey of travel patterns following opening of Metrolink Stage 1. (Examined trip times and costs for actual trip and next best alternative mode).	Bus, LRT	Car available persons	A: 2.8, W: 2.2	***	No differences in wait time value bus v LRT.
SDG 1990	Cleveland, UK	SP surveys of 'between mode' and 'within mode' trade-offs.	Bus, car	Local trips (peak/off-peak)	A: 2.1, W: 2.2	**	W value based on wait time = half headway
SDG 1990	Manchester, UK	SP surveys re forecast demand for Metrolink LRT project. Interviews with car, bus and rail travellers. Involved pair-wise comparisons car v LRT, bus v LRT.	Bus, car, suburban rail	Local trips (short/long)	A: 0.9 (short), 1.9 (long) W: 1.8 (short), 3.8 (long)	**	W value based on wait time = half headway.
Van de Waard, 1998	4 cities, Netherlands	Survey of PT users re actual trip characteristics and next best alternative.	Bus, tram, metro	Local PT trips	A; 2.3 (access), 1.2 (egress) W: 1.4 (first stop)	**	Access value significantly higher than egress value, maybe in part cos most of trips were to CBD. W value based on curvilinear relationship wait time v headway (may partially explain relatively low value)

TABLE A1 : SYSTEM ACCESS (WALKING AND WAITING) TIMES – STANDARD SITUATIONS : DETAILED EVIDENCE							
Reference	**City**	**Basis of Valuation**	**Mode**	**Trip Characteristics**	**Valuations (factors on IVT)**	**Importance of Source**	**Additional Comments**
Jansson 1994	Stockholm, Sweden	SP studies of PT users (with/without car available) and car users. Series of SP games involving in-vehicle time, frequency, delay, price, vehicle standard and various types of passenger information.	Car, PT	Local trips	W: c.3.0 (headway less than 12 mins, no use of timetable)	*	
Kjoerstad 1996	5 cities, Norway	SP surveys of regular PT users in conjunction with the Norwegian trial scheme for PT development. Used SC analysis, based on respondent choice between different trip packages, pivoted on specific journey made.	Bus (mostly)		A: 2.5 average (Oslo 2.0) W: 1.5 average (Oslo 3.4)	**	
Prosser et al, 1997	Sydney, Australia	SP studies of car v PT, and heavy rail v LRT v bus mode choice in connection with new urban rail line proposal.	Car, Urban rail, LRT, bus	Local trips, AM peak	A: 1.4 overall (1.3 for PT users, 2.3 for car users) W: 1.3 – 1.4 overall	**	Wait-time derived as 0.65-0.70 times service interval.

TABLE A2 : SYSTEM ACCESS (WALKING) AND WAITING TIMES - NON-STANDARD SITUATIONS : DETAILED EVIDENCE							
Reference	**City**	**Basis of Valuation**	**Mode**	**Trip Characteristics**	**Valuations (factors on IVT)**	**Importance of Source**	**Additional comments**
Ryan (LT) 1996	London, UK	SP(?) Studies – 1980	Metro		A: Escalators – walk up 4.2 - walk down 2.8 A: Stairs – walk up 4.4 - walk down 3.0 A: Escalators/lifts – riding 1.5		All values relative to in-train time 1.5 factor is conventional (comparable to standing on trains).
		SP study (1985), and other	Metro		W: 3.0: waiting for lifts		Standard LT waiting time factor (vehicles, lifts) = 2.0 Notes likely different values for bus and metro. Notes information reduces value by 10-20%.
		RP study (1985)	Metro		W: 3.0: Queuing for tickets etc		Standard value adopted by LT.

TABLE A3 : UNEXPECTED (SERVICE) DELAYS : DETAILED EVIDENCE							
Reference	**City**	**Basis of Valuation**	**Mode**	**Trip Characteristics**	**Valuations (factors on IVT)**	**Importance of Source**	**Additional comments**
Ryan 1996	London, UK	SP studies, 1983	Metro		Delays with information c.1.0 Delays without information c.3.0		'With info' figure seems low. Delays in crowded conditions valued 2-3 times uncrowded conditions.
Institute of Transport Economics 1993	Oslo, Norway	SP studies, local bus passengers	Local bus		4.9 – based on avoiding unforeseen 5 mins delay.		
Janssen 1994	Stockholm, Sweden	See above	Car, PT	Local trips	Delay time, relative to scheduled time c.12 (for people using timetables).	*	
BAH 1997	General	Summary of review of evidence on the effects of service unreliability and the valuation of 'unexpected' waiting time.	Local PT	All local trips	'Unexpected' waiting time valued at 2-3 times ordinary waiting time/	**	

APPENDIX B : IN-VEHICLE ATTRIBUTES

This Appendix provides the detailed evidence from the sources identified on user valuations of time spent in-vehicle.

This evidence is presented in Table B1. As in Appendix A, valuations are expressed relative to base values of time savings for in-vehicle (seated) passengers on that mode in 'standard' conditions.

The evidence relates primarily to the valuation relativities for standing passengers and in crowded conditions.

Full source references are given in Appendix F.

TABLE B1 : SYSTEM ACCESS/EGRESS FEATURE VALUATIONS : DETAILED EVIDENCE							
Reference	**City**	**Basis of Valuation**	**Mode**	**Trip Characteristics**	**Valuations (factors on IVT)**	**Importance of Source**	**Additional Comments**
Ryan 1996	London, UK	RP (1987) – passenger choice between crowded and empty trains SP (1985)	Metro Metro	Peak users	Factor = 1+R, with max = 2.5 R = 1.42 (x+0.048), where x = proportion of available standing space which is filled. Factor = 3.5 for standing in crowded train.		Result dependent on assumed valuation for waiting. Small samples only.
Institute of Transport Economics, 1993	4 cities, Norway	SP surveys, local bus passengers	Local bus		Standing 1.6-2.0 times seated valuation.		
Kjoerstad 1996	5 cities, Norway	See above	Local bus (mostly)		Standing ave 3.0 times seated valuation (2.0 for Oslo).		

APPENDIX C : TRANSFER PENALTIES

This Appendix provides the detailed evidence from the various sources identified on user valuations of 'transfer penalties', relating to transfers between public transport modes/services.

A transfer between two public transport services involves:

- Walking time
- Waiting time for the second service
- Perceived inconvenience of transfer.

The first two of these components are covered through valuations of walking and waiting time (as in Appendix A). This Appendix only covers the third component, ie the additional perceived inconvenience of transfers.

The evidence is detailed in two tables:

- Table C1 – evidence on the valuation of transfer penalties for urban public transport travel.
- Table C2 – evidence on factors which affect use valuations of transfer penalties.

Full source references are given in Appendix F.

TABLE C1 EVIDENCE ON VALUATION OF PT TRANSFER PENALTY

Source	Study/City	Mode From-To	Trip Purpose	Other Characteristics	Value (equiv in-vehicle mins)	Notes
Charles River Associates 1989	Chicago	Bus-bus	Work		18-37	Increases with in-vehicle time. Based on Horowitz (1981)
	Boston	Bus-LRT	All		15-27.5	Equivalent to 6-11 mins additional waiting time. Lowest values with attractive stations. Penalty increases with trip time: penalty is c.75-80% of total trip IVTT
	Ottawa	Bus-bus	All		22-30	Derived from transfer elasticity (-0.35) as 11-12 mins OVTT
	Edmonton	Bus-LRT	All		12-25	Derived as 5-10 mins OVTT
	Honolulu	Bus-bus	Work/non-work		5.8	
	Stockholm	All	Work		15	Typical figure for transfers involving metro, rail, bus. Metro-metro much lower than average, bus-bus much higher.
	Taipei	Bus-bus	All		30	Equivalent to 5-10 mins OVTT. High value may reflect reluctance to transfer because of bus over-crowding
	Recommendations for Houston Metro		Peak/Work		20	Expressed as OVTT value of 8 mins (peak) and 6 mins (off-peak). Same values for bus transfers and rail transfers (assuming high quality, co-ordinated bus transfers).
			Off-peak/ non-work		15	
British Rail 1989	UK –SE/ London	Rail/metro -rail/metro	All	Alternative NSE/LUL route choice	c.5	
			All	Medium/long NSE services	c.20	
			All	Recommended urban trips	10-14	Recommended value for British Rail forecasting purposes
Ryan, A 1996	London	Metro-metro	All		3.5(3.7 peak, 3.0 (off-peak)	Recommended values for use by LT/LUL in forecasting/ evaluation. Values dependent on assumptions re OVTT: IVTT ratios.
		Metro-rail	All		5	
TRRL 1980	UK, France				6-8	Expressed as 3-4 mins extra waiting time. Varies with interchange quality etc (refer Table 2).
Johnson & Adler 1988	New Jersey LRT (modelling)	?-LRT			10	Results of SP survey. Higher values for additional transfers.
Van der Waard 1988	Netherlands	Bus/tram/ metro	All	Interchange–minimal walk	4.2	Average 5.7 mins IVTT over all interchange types.
				Interchange–walk, flat	8.2	
				Interchange-walk, height	9.2	
Standeby, I	Oslo	Bus-bus		Regular travellers	8-10	

TABLE C1 EVIDENCE ON VALUATION OF PT TRANSFER PENALTY

Source	Study/City	Mode From-To	Trip Purpose	Other Characteristics	Value (equiv in-vehicle mins)	Notes
Horowitz, AH 1994				Open air, services not co-ordinated Cover, services not co-ordinated Open air, services co-ordinated Cover, services co-ordinated	32 16 8 4	GVC has original source?
Piotrowski, SM 1993a,b	Perth (1993 B/A Survey of NSTS passengers)	Bus-bus Bus-rail	Work/school Work/school		8.2/9.3 6.1/6.3	Perceived penalties Before/ After NSTS opening.
Prosser et al 1997	Sydney (SP studies re Parramatta - Chatswood Rail Link)	Rail-rail Bus-rail Rail-bus	AM peak AM peak		6 11	

TABLE C2 TRANSFER PENALTY FACTORS		
Source	**Location/Type**	**Comment**
Charles River Associates 1989/Vaga & Shortreed, 1982.	Edmonton, Canada: results of LRT introduction	Bus-rail transfer penalties less than bus-bus penalties LRT with 3 mins transfer time reduced all day transit demand by 15-20%; with 5-10 mins transfer time reduced demand 25-30% (relative to direct bus route).
British Rail 1989		Large number of factors which influence a passenger's valuation of the inconvenience of changing trains, including: • waiting time • walking time • frequency of services • reliability of services • ease of interchange • facilities • familiarity • journey purpose • traveller characteristics • other (eg anxiety about getting a seat, or missing a connection). Transfer penalty increases with both rail journey distance and connection time.
TRRL 1980	Stockholm	Interchange penalty affected by quality of interchange: Underground to Underground only small penalty because of weather protection (and possibly because high reliability); then in ascending order of penalty: rail to rail, bus to rail, and bus to bus. If the interchange takes place in unpleasant surroundings the transfer penalty should be increased; if, on the other hand the surroundings are well lit and pleasant with shops and kiosks, lower penalty should be applied.
Johnson & Adler	New Jersey (LRT)	Marginal value of transfer penalty increases for each additional transfer.
Piotrowski, SM 1993	Perth Survey: Before/ After opening of NSTS	Passenger's valuation of the transfer penalty increased after actually experiencing it ie their perception prior to using the new system which required transfers was lower than their valuation after using it. The increase was from 8.2 mins to 9.3 mins for bus to bus, and 6.1 mins to 6.3 mins for bus to train.

APPENDIX D : MODE-SPECIFIC FACTORS

D1 INTRODUCTION

As discussed in the main text (Section 2.5.1), mode-specific factors or **mode-specific constants** (MSC) are important to the demand modelling and evaluation of urban public transport projects involving the introduction of new modes or the replacement of one public transport mode by another.

This Appendix investigates international evidence on:

- Actual behaviour following the introduction of new public transport modes in urban areas, and its implications for MSC values.
- Stated intentions towards use of new systems not yet introduced, from SP surveys.
- How actual usage (RP data) compares with state intentions (SP data) from 'before and after' studies of new/improved public transport systems.

The evidence from each of the sources examined is presented in the following sections.

D2 REVEALED PREFERENCE EVIDENCE

D2.1 Manchester Metrolink Studies (Halcrow Fox 1995)

The Manchester Metrolink project involved the linking of two heavy rail lines with on-street running through Manchester CBD, and introduction of new LRV stock on the system. The first stage of the project was opened in 1992.

Various 'before and after' monitoring surveys have been undertaken, including analyses to develop RP parameters for light rail (for the first time in the UK), as an input to studies for proposed extensions of the first stage network. These analyses primarily relied on random household surveys undertaken in the Metrolink catchment area in May 1993. These surveys collected information on reported times and costs for recent journeys, along with times and costs for the same journey if undertaken by the next best alternative mode.

The survey samples covered 632 individuals with a car available, 122 without car available. For the car available sample, the following table summarises model statistics, based on a hierarchical model structure.

TABLE : MANCHESTER METROLINK DISAGGREGATE CAR AVAILABLE PARAMETERS

Variable	Parameter	Peak Value	Off-peak Value	Parameter: In-vehicle Time
In-vehicle time	-0.0436	6.7p/min	4.5p/min	
Walk time	-0.1225	18.8p/min	12.5p/min	2.8
Wait-time - bus	-0.0968	14.8p/min	9.9p/min	2.2
Wait-time - Metrolink (1)	-0.0968	14.8p/min	9.9p/min	2.2
Constant - bus	-0.8396	-129p	-85.8p	-19.2
Constant-Metrolink	0.1355	20.8p	13.9p	3.1

Note: (1) Metrolink wait time coefficient constrained to equal bus wait time coefficient.

Similar analysis of the non-car available sample was not successful because of the sample size being too small. Further analyses, using the full sample, indicated no clear distinction between modal constants for bus and Metrolink for non-car available persons.

Separate analyses of existing travel data in the area then served by heavy rail found a high negative MSC for rail relative to bus: this indicated that the high degree of rail unreliability and poor security at rail stations and on access/egress routes to the stations had adverse effects on system attractiveness and demand.

In summary, the study findings relevant to the determination of MSC values were:

- For travellers with a car available, the relative MSC for Metrolink (LRT) over bus on-street was around 20 minutes in-vehicle time.
- For travellers without a car available, the relative MSC appeared not substantially different from zero.
- The MSC for the existing heavy rail services relative to bus on-street was negative, reflecting in part perceptions of poor reliability and security of the rail services. (A similar result was obtained for the old Auckland rail services).

D2.2 Adelaide O-Bahn (Bray, 1995)

- 1994 patronage on the O-Bahn was estimated at 45% higher than the equivalent patronage in the corridor in the absence of the O-Bahn facility.
- The O-Bahn reduced bus travel time over its route length (Tea Tree Plaza - CBD) from 33 minutes to 23 minutes, a saving of 10 minutes or 30%.
- Based on an elasticity of PT demand with respect to travel time of -0.5, a patronage increase of about 15% would have been expected in response to the travel time savings.
- This suggests that other (non-time) features of the O-Bahn (comfort, ride quality etc.) have accounted for two-thirds of the total patronage increase, i.e. an increase of about 30%.
- Given that a 15% patronage increase is associated with a 10 minute time saving (using conventional elasticities), this suggest that the 'O-Bahn effect' is equivalent to a **20 minute reduction in in-vehicle time**, or **about 30% patronage increase**.

D2.3 International Practice (Abelson 1995, quoting Fouracre 1990)

> *"Many studies have found that, other things being equal, most public transport users prefer rail to bus because of its greater comfort. To model this choice accurately, a penalty of **four to six minutes** must often be attached to bus travel to reflect the relative discomfort of buses."*

D2.4 Dutch Sub-mode Choice Behaviour (van der Waard, 1988)

This project involved interviews with PT users at stops in areas where they had a choice of route/mode, and calibration of the utility function in a multinomial logit model (note that this model did not have an MSC term).

It was found, inter alia, that the value of time savings (VTTS) for on-street trams was equal to that for buses; but that the value for segregated rapid transit services (suburban rail, metro, segregated trams) was 10% lower. (It is possible that the MSC is fully reflected in this difference, given the absence of a constant term in the utility formulation.)

D3 STATED PREFERENCE EVIDENCE

D3.1 UK Stated Preference Studies (Ref: Kilvington, 1991)

This paper reviews and summarises the results of various urban transport SP surveys by SDG in the United Kingdom.

It finds the MSC values for PT modes by current car users, averaged over 10 studies, are as follows:

Mode	MSC relative to Car (GC mins)
Light Rail	-11
Heavy Rail	-14
Guided Bus	-17
Bus on-Street	-25.5

The paper comments that:

> *"In terms of the 'direct' modal penalties, a choice spectrum can again be clearly discerned with light rail and guided bus substantially preferred to conventional bus. Light and heavy rail appear to be perceived similarly although the presumably unfavourable comparison of all modes with the Tyne & Wear Metro is notable."*

D3.2 Dublin Stated Preference Survey (Kilvington, 1991)

This letter quotes the results of an SP survey in Dublin undertaken by SDG.

It finds the following MSC values for peak period travel by current car and current bus users.

Mode	MSC - minutes	
	Current Car Users (relative to car)	Current Bus Users (relative to on-street bus)
Light Rail	-11	+16
Suburban (Heavy) Rail	-11	+16
Guided Bus	-22	+12
Bus-on-Street	N/A	0

The letter comments that:

> *"The results indicate an underlying resistance to both light rail transit and guided bus on the part of car users, but a much more significant penalty in relation to guided bus. The light rail transit penalty, incidentally, was found to be statistically indistinguishable from that attributed to DART, the existing metro-style 'heavy rail' system in Dublin, both for car users and bus users."*

D3.3 London 'RAILPLAN' Stated Preference Literature Review

This study included a review of the results of SP research undertaken by various UK consultants in the late 1980s/1990s. The results are summarised in the following table.

TABLE: VALUES OF SP MODAL PREFERENCES BETWEEN TRANSIT SYSTEMS (Units of in-vehicle time minutes)

System	Car User Penalty	Bus User Penalty
Light Rail	9.1	-8.2
Guided Bus	16.5	-8.6
Heavy Rail	17.5	-7.4

Source: SDG SP Applications To Light Rail 1993 Halcrow Fox and Others.

Notes: Some outlier values excluded (these generally gave large values of time in favour of LRT etc over car).

The review notes that, while there is quite a marked variation in results between studies, a general picture emerges that:

- Bus users preferred other modes (guided bus, light rail and heavy rail) by a value of some eight minutes. All three alternative modes received very similar valuations.
- Car users all preferred a car to any form of public transport, but of the public transport modes light rail was regarded as some eight minutes better than both guided bus or heavy rail.

In general, bus users prefer the alternative public transport modes by a roughly equal amount, while car users (though disliking all public transport) tended to prefer Light Rail to either existing rail systems or new guided bus systems.

The study notes several points in interpreting the SP results:

- Comparisons are not like with like, eg light rail and guided bus are generally described as new modes while heavy rail is often described as either an existing mode or one which will be introduced on an old line with existing rolling stock and slightly refurbished stations etc.
- Information such as reliability is generally not included in the stated preference experiments, meaning that respondents will be making their own assumptions about the performance of different modes.

The study also investigated in more detail the underlying reasons for the modal preferences. These investigations showed that appearance was important, in terms of cleanliness and modernity; but that modern appearance also influences respondents into thinking that the modes may be more reliable.

D3.4 Canberra Stated Preference Survey (Denis Johnston & Associates)

This SP survey was concerned with attitudes of present car users and bus users in Canberra to a Busway-based system, a Guided Busway (O-Bahn) system and an LRT system. Car users were asked, for each defined mode, whether they would use PT under different scenarios of fare, car journey time, parking cost and petrol prices. Bus users (with car available) were asked to indicate at what fare they would shift back to car under different PT system options.

The propensity to shift to PT by car users was very similar for all modes, indicating "very little perceived difference between the various modes in terms of the propensity to shift."

Respondents were also asked to rate the modes in order of preference. For car users it was found that LRT was preferred to Busway, which was in turn marginally preferred to O-Bahn. For bus users, Busway was preferred to LRT, which was marginally preferred to O-Bahn.

However, it was noted that "the ratings are very close and may not indicate a significant preference for one mode over another."

This survey is of interest as it took place in a city which has a relative high standard of bus service, little affected by traffic congestion.

D3.5 Sydney Stated Preference Survey (Prosser et al)

This SP survey was concerned with preferences of AM peak travellers in Sydney's Parramatta-Chatswood corridor between car, suburban rail, LRT and bus modes: it was undertaken as part of studies into the proposed Parramatta – Chatswood rail link.

The SP surveys were used to calibrate mode choice models, both between car and PT and for choice of PT sub-modes. These models assumed that the MSC was a fixed value independent of travel time on the mode. On this basis the following MSC values were estimated:

(i) MSC preference for car relative to PT was:
- 8 mins overall
- 30 mins for car users
- -9 mins for PT users.

(ii) MSC preferences between PT modes were:
- Urban rail preferred to LRT by c. 5 mins
- LRT preferred to bus by c. 4 mins.

D4 REVEALED PREFERENCES COMPARED TO STATED PREFERENCES

D4.1 Illinois Bus 'Before and After' Studies (Couture and Dooley)

This study involved a telephone survey both one month before and eight months after the introduction of a bus transit system in Danville, Illinois in 1977.

A binary logit model, using a utility function, was used to represent the intended (before) or actual (after) choice of mode. The independent variables in the utility function included measures of:

- perception of transit level of service relative to other modes
- explicit feelings or biases towards transit or the automobile
- underlying psychological attributes
- modal availability
- degree of intended transit use.

Most variables were expressed as a binary (O, 1) choice:

The study conclusions of most interest are reported as follows:

*"The cross-tabulation results showed that **81 percent** of the women and **71 percent** of the men in the sample **intended to use** transit and that only **35 percent** of the women and **24 percent** of the men **actually** used it. This translates into **approximately three intenders for every actual user** and confirms the earlier assertion regarding intentions overstating actual behaviour. There were no significant differences among age or employment groups with respect to intended or actual use of transit.*

The results also showed that 37 percent of those who said they intended to use transit did use it whereas 84 percent of those who did not intend to use transit in fact did not. This is consistent with the consumer research literature, in which negative intentions have been found to be better indicators of non-use than positive intentions are of use."

"Further analyses indicated that 63 percent of those who had no car available used transit whereas only 25 percent of those who had a car used transit. Among those to whom a car was available, 29 percent of those who intended to use transit did and only 11 percent of those who did not intend to use transit did use it. A similar pattern (20 percent difference) existed among those who did not have an automobile available, which suggests that intention is in fact important in determining use."

D4.2 Miami Metrorail 'Before and After' Studies (Sheskin)

Surveys were undertaken at the University of Maryland before and after the opening of the Miami Metrorail, to compare stated intentions to use the line with actual usage.

The Before survey of stated intentions indicated that about 1700 people would use Metrorail to/from the campus on an average weekday. The After survey showed that daily usage was about 350 people, just over 20% of the stated intentions.

The study report quotes Couture and Dooley's finding that:

> *"actual behaviour can be predicted from behavioural intent by dividing behavioural intent by a number between 3 and 5."*

It comments that this finding appears to be valid in the Miami case (despite the 4 year gap between the before and after surveys, during which most of the students will have changed).

Other comments in the paper include:

- 54% of the University users were male; although males had out-numbered females by 5:1 in those intending to use the system in the before survey.
- For the Metrorail system as a whole, actual usage was (after 5 years) only around one-sixth of the use projected prior to opening.

D4.3 Christchurch Bus Stated Preference Survey (Tony Francis/Travers Morgan)

In a study into factors affecting bus usage in Christchurch, interviewees were asked how likely they would be to use the bus for a specified recent trip (when they had not used the bus) if the services were changed, e.g.

- the fares were halved
- the service frequency was doubled
- the bus ran express
- the trip could be made without changing buses.

In each case responses were obtained on a 5-point scale: almost certainly (would use the bus), very likely, quite likely, unlikely, most unlikely.

The stated changes in modal use were then compared with estimated elasticity of demand values, reflecting the range of experience from many studies as to how people actually modify their behaviour in response to fare and service changes. It was found that:

- Taking only "almost certainly" responses as reflecting new bus trips over-stated the expected effects (based on elasticity values) by a factor of 4-5.

- Taking the "almost certainly" plus "very likely" responses as reflecting new bus trips overstated the expected effects by a factor of 5-8.

APPENDIX E : 'SOFT' VARIABLES

This Appendix presents the detailed research evidence on valuations of 'soft' variables for train and bus in the following four tables:

- Table E1 : Rail : Station Attributes
- Table E2 : Rail : On-Train Attributes
- Table E3 : Bus : Stop Attributes
- Table E4 : Bus : On-Bus Attributes.

An overview and discussion of the evidence is given in Section 2.6.

TABLE E3 : BUS SOFT VARIABLES - BUS STOP ATTRIBUTES

ATTRIBUTE	VALUATION			
	Value	Currency	IVT Minutes	% Fare
Information at Home				
Timetables at home	5.5	UK, pence per journey 1997 prices	1.0	
Maps at home	3.9	UK, pence per journey 1997 prices	0.7	
Phone service	2.8	UK, pence per journey 1997 prices	0.5	
Customised local information at home	2.0	UK, pence per journey 1997 prices	0.4	
Bus Stop Infrastructure				
Basic shelter with roof and end panels	5.6	UK, pence per journey 1997 prices	1.0	
Basic shelter with roof only	4.5	UK, pence per journey 1997 prices	0.8	
Lighting	3.1	UK, pence per journey 1997 prices	0.5	
Moulded seats at stop	3.4	UK, pence per journey 1997 prices	0.6	
Flip seats at stop	2.2	UK, pence per journey 1997 prices	0.4	
Bench seats at stop	0.9	UK, pence per journey 1997 prices	0.2	
Payphone at stop	3.8	UK, pence per journey 1997 prices	0.7	
Bus Stop Environment				
Dirty bus stop	-11.8	UK, pence per journey 1997 prices	-2.1	
Information at Bus Stop				
Guaranteed customised local information at stop	9.9	UK, pence per journey 1997 prices	1.7	
Countdown to next bus arrival	9.0	UK, pence per journey 1997 prices	1.6	
Guaranteed current information at stop	8.8	UK, pence per journey 1997 prices	1.5	
Boarding				
Compulsory stop versus request	1.7	UK, pence per journey 1997 prices	0.3	
Bus pulls in close to kerb	5.8	UK, pence per journey 1997 prices	1.0	
Externally shown route number and line diagram	2.8	UK, pence per journey 1997 prices	0.5	
Low bus entry versus high steps	2.4	UK, pence per journey 1997 prices	0.4	
Split steps versus high steps	-0.3	UK, pence per journey 1997 prices	-0.1	

Notes:

Steer Davies and Gleave cited in London Transport (1997) "Business Case Development Manual", LT Corporate Planning
All valuations based on maximum improvement (i.e. poorest condition to perfect condition),
Monetary values converted using recommended value of time (i.e. 5.7 pence per minute 1997 prices)

TABLE E4: BUS SOFT VARIABLES - ON-BUS ATTRIBUTES

ATTRIBUTE	VALUATION			
	Value	Currency	IVT Minutes	% Fare
Driver				
Appearance with ID badge	2.2	UK, pence per journey 1997 prices	0.4	
Appearance with helpful attitude	1.9	UK, pence per journey 1997 prices	0.3	
Driver gives change when needed	4.0	UK, pence per journey 1997 prices	0.7	
Helpful driver	1.5	UK, pence per journey 1997 prices	0.3	
Smart driver appearance	0.1	UK, pence per journey 1997 prices	0.0	
Moving to Seat				
Extra standing room to replace luggage area	2.0	UK, pence per journey 1997 prices	0.4	
Standard seats	1.1	UK, pence per journey 1997 prices	0.2	
Bucket seats versus standard seats	-1.1	UK, pence per journey 1997 prices	-0.2	
Some seats sideways on	-3.0	UK, pence per journey 1997 prices	-0.5	
Medium crowd versus low	-4.7	UK, pence per journey 1997 prices	-0.8	
High crowd versus low	-9.5	UK, pence per journey 1997 prices	-1.7	
Medium vehicle motion versus smooth	-6.3	UK, pence per journey 1997 prices	-1.1	
Rough vehicle motion versus smooth	-10.5	UK, pence per journey 1997 prices	-1.8	
Travelling				
Roomy seats versus cramped	3.0	UK, pence per journey 1997 prices	0.5	
Ventilation versus opening windows	-2.5	UK, pence per journey 1997 prices	-0.4	
Dirty bus interior	-8.5	UK, pence per journey 1997 prices	-1.5	
Leaving the bus				
Electronic display of next bus stop name	3.9	UK, pence per journey 1997 prices	0.7	
Driver announcements on PA	-0.9	UK, pence per journey 1997 prices	-0.2	
Two sets of doors versus single set	4.2	UK, pence per journey 1997 prices	0.7	

Notes:

Source:
Steer Davies and Gleave cited in London Transport (1997) "Business Case Development Manual", LT Corporate Planning
All valuations based on maximum improvement (i.e. poorest condition to perfect condition),
Monetary values converted using recommended value of time (i.e. 5.7 pence per minute 1997 prices)

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