Public Transport Mobility/Accessibility Benefits for New Zealand

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Executive Summary

Introduction

The aim of this research undertaken in 2001 was:

"To review the latest research on mobility benefits of public transport services and to quantify the economic value of the mobility benefit of the existing base passenger transport network of major urban centres in New Zealand."

The research project was undertaken in two stages.

Stage 1 involved:

- *Preparation of a 'Thinkpiece':* to develop the definition and scoping of public transport mobility/accessibility benefits.
- *Review of international literature* on public transport mobility/accessibility benefits.
- *Critique of methods* available for estimating public transport mobility/accessibility benefits.

Stage 2 involved:

- *Estimation of mobility/accessibility benefits* of existing public transport systems for New Zealand by applying the quantification methods which passed the Stage 1 critique, and which did not involve new research (i.e. could be applied to existing data).

Mobility/Accessibility Benefits: Definition & Scoping

'Mobility' can be defined as:

the ability and ease of individuals to move or travel in the greater community.

For the purposes of this project, 'accessibility' is defined as:

the ability and ease of all members of society to obtain the goods, services and activities required for a reasonable quality of life.

Accessibility is the primary objective of most public transport trips, while mobility is not usually an end in itself for such trips. The analysis and reporting was therefore carried out in terms of identifying public transport accessibility benefits rather than mobility benefits.

The final list of public transport accessibility benefits used in this project (derived from the 'think-piece' and the international literature review) follows.

A[1]	More efficient public facilities
A1	- Reduced cost of serving population (e.g. medical cross-sector benefits)
A2	- More efficient location/design of public facilities
B	Producer benefits (better choice of employees, greater retail and services sales)
C	More efficient city and regional centres
D	Increased opportunity for employment, education & other activities (individual benefit)
D1	- not PT dependent
D2	- PT dependent
E	Equity value
F	Option value (non-users)
G	Existence value
H	Amenity value
I	Altruistic value

[1] Letters A – I relate to descriptors used in literature review, and subsequently in the report

Potential Methods for Estimating Public Transport Accessibility Benefits

The eleven potential methods for benefit estimation derived from the international literature review are summarised below, and allocated to their applicable public transport accessibility benefit type.

Potential methods for estimating public transport (PT) accessibility benefits

Method	Description	Benefit Type
Medical Trip Replacement	Based on user surveys to identify medical home-visit replacement rates for accessible PT	A1
PT Service Removal Impact	Generally based on surveys of ex-users of terminated PT services to assess impact on access to employment, medical and other opportunities (can also be 'what-if' survey of current users)	D
Willingness-to-Pay for PT Survey	Carry out survey of users and non-users to ascertain their willingness-to-pay to retain a PT service	D, G, H, I
Fiscal Model	Aggregate model based on results of user surveys plus elasticities wrt funding and services provided, and proportion of trips that divert to welfare programmes if PT is reduced	A1
Employment Function	Based on user surveys, identifies number of people with disabilities enabled to work by PT; and net public cost savings	A1
Efficiency Measurement	Measure efficiency of different sized institutions; and establish PT role in this	A2
Production Function	Develop production function showing the different inputs needed to produce a given level of output (including PT services)	A2
Employer Subsidy	Identify amount employers pay towards 'workers buses' to establish value of service to them	B
Hedonic Pricing-Property Values	Carry out multi-regression analysis with property value as dependent variable and proximity to rail station one of the independent variables	B, D, F
Multi-regression Analysis – Urban Areas	Carry out multi-regression analysis on urban areas, productivity and growth as dependent variables, presence of transit one explanatory variable	C
Consumer Surplus	Determine demand curve for PT trips against fare. Area between curve and fare line is 'consumer surplus' and represents 'mobility benefit'	D

Assessment of Benefit Estimation Methods

The benefit estimation methods were assessed to select suitable methods for the Stage 2 benefit quantification. The assessment criteria used were:

- Theoretical Robustness,
- Experimental,
- Useful Results,
- Widespread Applicability,
- Data Requirements.

Applying these criteria to the benefit estimation methods, seven had potential use for the proposed Stage 2 application of these methods. They are:

Medical Trip Replacement, Public Transport Service Removal Impact, Willingness-to-Pay for Public Transport Survey, Employment Function, Hedonic Pricing – property values, Multi-regression Analysis – urban areas, Consumer Surplus.

Methods that did not pass the selection criteria are: Fiscal Model, Production Function, Employer Subsidy, and Efficiency Measurement.

Assessing the Impacts of Service v Subsidy

An important issue addressed in this research is whether benefit estimates are to represent either the total benefits from existence of the public transport system, or the benefits of public funding (subsidy) to the system. Even in the absence of subsidy, some level of public transport service is likely to remain in at least the larger New Zealand centres. From the public funding viewpoint, the incremental benefits of subsidy may be of most interest, and they are certainly appropriate when assessing changes to the base system.

The benefit estimation methods fall into three groups:

- Methods that can readily measure the benefits of a change in service (and hence subsidy): e.g. user surveys, Multi-Regression Analysis, and Willingness-to-Pay Survey.
- Methods that cannot be readily adapted to measure service change (and hence subsidy) benefits: e.g. Employment Function, Hedonic Pricing.
- Methods that can possibly be adapted to measure subsidy changes: e.g. Consumer Surplus.

A more fundamental issue is whether the benefits covered by these methods are already covered by conventional benefit/cost analysis which could (in theory) be applied to public transport system changes. This is currently the case for Transfund New Zealand's Alternatives to Roading (ATR) and Patronage Funding schemes.

Certain community and non-user benefits were found not to be covered by the current ATR and Patronage Funding evaluation frameworks. These benefits include: More Efficient Public Facilities, More Efficient City & Regional Centres, Option Value, Existence Value, Amenity Value, and Altruistic Value.

Quantification of Public Transport Accessibility Benefits for New Zealand

Indicative estimates

An indicative estimate of the monetary value of different public transport accessibility benefits derived from the exploratory application of the available estimation methods and using the values obtained from international studies are listed below. (These estimates provide only an indication of the relative size of the different benefit types and are not presented as accurate benefit values.)

Total (indicative) annual benefit for identified accessibility benefits is – and consists mostly of:	$329M – 683M
Increased Opportunities for Public Transport Users (PT dependent, not-PT dependent) –	$88-$412M
Option Value for Non-Users –	$133M
More Efficient City & Regional Centres –	$75M

Indicative benefit values could not be estimated for a number of benefit types because of the lack of identified methods and benefit values. However, these latter benefits are likely to be captured within several of the other benefit types (because of the manner in which they have been measured).

Stage 2 analysis

Further analysis was undertaken for two benefit estimation methods that passed the selection criteria, to attempt to apply them to New Zealand data.

1. Medical Trip Replacement

This methodology assesses the net benefit in the Reduced Cost of Providing Medical Services for people able to access Accessible Public Transport (APT) services. However, the data required for this methodology are not currently available in New Zealand, and the methodology has not been applied. The UK study results derived considerable savings of Reduced Cost of Serving the Population of $27–$36M for an APT system, or $1–$1.4M for the existing Total Mobility service. This is a potentially fruitful area for further research.

2. Consumer Surplus

This methodology assesses the Increased Opportunity for Employment, Education & Other Activities (individual benefit) for all users. It represents the net benefit that travellers experience from using public transport for their trips.

The user accessibility benefits associated with use of the local public transport system in New Zealand are about $200M per annum. They represent net aggregate user benefits as perceived by travellers, and amount to:

- about $2.40 per current trip, which is
- about 2.4 times the current average fare, and/or
- about 2.4 times the existing subsidy levels.

Next Steps

Public transport accessibility benefit types exist for which an indicative benefit quantification suggests that a substantial dollar value can be obtained if they were to be applied to public transport systems in New Zealand. However, quantifying their benefits for New Zealand has not been possible because of the lack of information that is publicly available. Option Value and More Efficient Cities & Regional Centres are the benefit types likely to provide the highest benefit values (indicative estimates of $133M and $75M respectively). These should be therefor the highest priority research areas.

Given the likely difficulty in obtaining adequate data for the method of estimating More Efficient Cities & Regional Centres, research into quantification of Option Value may be more successful.

Most of the benefit estimation methods available do not lend themselves well to quantification of system changes. Therefore the need is for research into adapting existing methods in order to value these changes, and for an examination of possible new methods which can do this.

Abstract

A research project undertaken in 2001 reviewed the latest research on mobility and accessibility benefits of public transport services. It also quantified the economic value of the mobility/accessibility benefit of the existing public transport network in major urban centres in New Zealand. The research project was undertaken in two stages.

Stage 1 involved definition and scoping of public transport accessibility benefits; review of international literature on these benefits; and critique of methods available for estimating them.

Stage 2 involved estimation of accessibility benefits of existing public transport systems for New Zealand by applying appropriate quantification methods identified in the Stage 1 critique.

Only the Consumer Surplus methodology, which measures the user accessibility benefits (increased opportunity for employment, education and other activities) for all public transport users, was able to be applied in the New Zealand context. User accessibility benefits of around $200M per annum were estimated.

1. Introduction

This report sets out the results of a research project entitled "Mobility Benefits of Public Transport" which was carried out in 2001 under the Transfund New Zealand Travel Behaviour Research Programme 2000-2001, by Booz Allen Hamilton in conjunction with Pinnacle Research.

1.1 Project Purpose

The overall purpose of the research project was:

"To review the latest research on mobility benefits of public transport services and to quantify the economic value of the mobility benefit of the existing base passenger transport network of major urban centres in New Zealand."

In addition, the project was to:

- *"consider the distinguishing characteristics between mobility benefits and accessibility benefits while developing possibilities for the application of mobility benefits within the evaluation criteria and processes for individual projects; and,*
- *"if the mobility benefit is a worthwhile measure, ... develop a simple procedure by which the mobility benefit of changes to that base network can be quantified. In addition, a basis upon which such services can be evaluated may be developed."*

1.2 Research Programme

The research project was undertaken in two stages.

Stage 1 involved
Preparation of a 'Thinkpiece' in which the definition and scoping of public transport (PT) 'mobility' and 'accessibility' benefits were developed. This theoretical exercise (in part Chapter 2 and in full as Appendix 1 of this report) was necessary to clarify which benefits would be included as public transport mobility/accessibility benefits, which benefits are already included in current New Zealand evaluation frameworks, and which benefits are 'resource' benefits. The Thinkpiece (Appendix 1) shows the initial lines of thought that were followed. It was revised following the review of international literature.

A review of international literature on public transport mobility/accessibility benefits (Chapter 3 of this report), with a particular focus on methods available for quantification of these benefits, and actual values reported.

Critique of methods available for estimating public transport mobility/accessibility benefits in terms of their validity, usefulness and applicability to New Zealand (Chapter 4).

Stage 2 involved

Estimation of mobility/accessibility benefits of existing public transport systems for New Zealand (Chapter 5) by applying the quantification methods which passed the Stage 1 critique.

1.3 Report Layout

This report is set out as follows.

Chapter 2 sets the scene (extracted from the Thinkpiece) and discusses the definition and scoping of public transport mobility/accessibility benefits.

Chapter 3 sets out the main findings from the review of international literature on public transport mobility/accessibility benefits.

Chapter 4 provides a critique of potential methods for estimating public transport mobility/accessibility benefits.

Chapter 5 provides the results of applying methods for estimating public transport mobility/accessibility benefits to the New Zealand public transport system.

Chapter 6 discusses the next steps in researching mobility/accessibility benefits.

Appendix 1 Public Transport Mobility Benefits Thinkpiece (in full)

Appendix 2 Literature Review Summary, in which summaries of the findings from relevant literature are tabulated.

Bibliography lists references used in the Literature Review, and completes the report.

2. Mobility/Accessibility Benefits: Definition & Scoping

2.1 Setting the Scene

The social goals of government often encompass the desire to ensure that all citizens have equal opportunity to access essential and other social, cultural, and recreational services in their region. Essential services may encompass medical-, educational- and employment-related services, as well as more basic needs such as food and housing. Government equity objectives are generally focused on income redistribution, so that those who are less well off are made better off by favourable public policies and subsidies. In the transport sector, governments may provide subsidies for specific groups of people who are thought to be transport-disadvantaged and/or provide passenger transport services for their use in an effort to reduce inequalities in access.

The New Zealand Government has clearly indicated its goal of equal opportunity for access for all New Zealanders. In February 2000, it released a document entitled *Key Government Goals to Guide Public Sector Policy and Performance* in which one of the goals is to "grow an inclusive, innovative economy for the benefit of all". The document emphasises that this type of economy adapts to change, provides opportunities, and increases employment and income, as well as "closing the gaps" between different groups in society. The *Ministry of Transport Strategic Plan 2001 – 2006*, in elaborating on the *Key Government Goals* states "mobility is a fundamental need for citizens to participate in society. Accessibility impacts on individual's ability to manage their lives". To achieve the Ministry goal of a sustainable transport system, the *Plan* identifies three objectives specifically related to accessibility and mobility:

1.2 Improve levels of accessibility for public transport services;

1.3 Improve transport's contribution to reducing inequalities;

1.5 Advance New Zealand's interests in and access to the global transport system.

The goal of a sustainable transport system has been suggested by researchers to have the following attributes:

- The focus of the transport system is improving accessibility rather than mobility;
- Each mode of transport is used for what it does best, and typically involves a reduction in private car use;
- Individual transport planning decisions are "subordinate" to the community's long-term planning objectives.

From the late 1990s, the New Zealand Government has addressed its equity objective in transport primarily through its 'social services output class' which includes the concession fares and other provisions for the 'transport disadvantaged'. While the Government has financially assisted the provision of public transport services and infrastructure, the principal benefits explicitly acknowledged in such funding have been related to congestion relief, accident reduction and improved environmental quality.

The Government makes its new investment decisions about public transport funding using two separate (but linked) frameworks. They are Transfund's evaluation systems for Alternatives to Roading (ATR; 1997) and Patronage Funding (2000) (set out in the respective Transfund Manuals).

The benefits valued in these frameworks tend to be those known as 'efficiency' benefits, including travel time savings, accident reduction and vehicle operating cost savings. Various groups within New Zealand society have argued that the Government should also recognise and account for the benefits related to improvements in accessibility and mobility in its decisions to fund public transport services and infrastructure.

2.2 Mobility or Accessibility: What is the Objective?

'Accessibility' is generally accepted to refer to the ability to obtain desired goods and services and the ability to reach desired activities and destinations. However, the meaning of 'mobility' is not so clearly seen as it sometimes refers simply to physical movement and at other times appears to have a definition similar to accessibility.

2.2.1 Definitions

A Definition of Mobility: For a government to attain its equity objective of equal access for all citizens to essential services, the key concept appears to be access, yet the loss of mobility often contributes directly to a loss of access.

Mobility can be defined as:

> *the ability and ease of individuals to move or travel in the greater community.*

A Definition of Accessibility: In the late 1980s, the UK Royal Commission on Social Policy declared that accessibility is a basic human right, rather than mobility:

> ... *people have a* right to access *necessary services and facilities. If their circumstances (income, age, disability) make it difficult for them to provide for their own needs and/or utilise existing services (if there are any) then there is a duty on public authorities to assist* (Good 1988, quoted in Sergejew 2000) (roman type added).

Thus for the purposes of this project, accessibility is defined as:

> *the ability and ease of all members of society to obtain the goods, services and activities required for a reasonable quality of life.*

To ensure equitable accessibility for all sectors of the public, the following objectives are recommended to be considered when preparing policy for passenger transport services.

2.2.2 Policy Objectives

- Mobility is only one means to accessibility, albeit an important one, where the loss of a mobility option often leads to the loss of access.

- Governments generally try to improve equity for their citizens, and they can particularly focus on equity of access to essential services.
- The primary purpose of mobility is to gain access. Mobility for mobility's sake is not a socially desired outcome.
- The primary purpose of accessibility is to ensure that all members of society have the ability to meet their needs for a basic quality of life.
- Improved mobility may not be the best choice to improve access.

Accessibility is the primary objective of most public transport trips, and mobility is not usually an end in itself for such trips. We therefore concentrate on public transport accessibility benefits rather than on mobility benefits in this report.

Some types of access are clearly going to be more important to society than others, and public support will be focused on them. Examples include access to medical services, to education, to employment, to shopping areas for basic needs such as food, and to a reasonable level of social and recreational activities by public transport services.

Improving accessibility, rather than mobility, should be a primary policy goal for government when funding public transport to achieve its social equity objectives. An emphasis on mobility assumes that travel is an end in itself, and so favours transportation policies that maximise physical movement, while an emphasis on accessibility assumes that mobility substitutes, as well as more efficient land use patterns, can also improve transportation.

Using these conclusions, the following points are addressed in Section 2.3:

- What are the specific benefits attributed to accessibility?
- Who receives these benefits? Are benefits confined to a particular trip purpose or person type?
- Should system-wide benefits be calculated, or should only benefits related to subsidy provision be calculated?

An understanding of these issues is critical if the New Zealand Government is to recognise and account for such benefits when making decisions about funding public transport services and infrastructure.

2.3 Types of Accessibility Benefits

1. More efficient public facilities

If public facilities, such as transport, can be more efficient because of economies of agglomeration (or economies of scale), and reduced expenditure on services, financial and resource savings in the public sector will accrue to the whole society. Larger sites with more specialised services can then be planned and executed because of better access.

After carrying out the Literature Review, this benefit type was split into:
1. Reduced cost of serving population; and
2. More efficient location/design of public facilities.

2. Producer benefits

These benefits occur when employers profit from the opportunity to get the best workers for their needs. Also retailers and service providers gain increased business and sales (WRC 2000).

Employees may capture benefit through wages (assuming a competitive market), and retailers and service providers may capture benefits of increased sales which show in their profits.

3. More efficient cities and regional centres

This includes economies of agglomeration. City and regional centres become more economically efficient because access to shops and services can be concentrated in certain areas (and specialised support services can be developed).

This benefit type may double-count benefits that are captured through measures for improved public facilities and producer benefits.

4. Increased opportunity for employment, education and other activities

These benefits include personal benefits to users arising from increased employment, education, recreation and social activities.

5. Equity value

These are the benefits, to both users and society, of providing mobility to people who are economically, socially or physically disadvantaged.

Improving basic access overcomes inequity and restores competitive advantage for non-drivers who can now compete for jobs and education. WRC (2000) noted that the disadvantaged may include under 16-year olds, lower socio-economic groups, people unfit to drive for medical reasons, and the elderly.

Currently, the New Zealand Government provides some targeted funding for the transport disadvantaged through Transfund's budget for Total Mobility (for those with physical or mental conditions) as well as concessions (reduced fares for children and the elderly). Measures for improved accessibility and increased employment, etc. may incorporate any equity benefit.

6. Option value

These are benefits to society from maintaining transport options in case of changes in individual or social needs. However, the distinction between expected use benefits and option value must be made. It may also be a willingness-to-pay measure.

This is defined as the "premium the community may be prepared to pay to retain the option of using resources in the future" (WCS 1993). Option values reflect the uncertainty over future preferences or needs.

For example the provision of a transport service as a back-up in case of emergencies or changed conditions is a value to the entire community, even to those who are not PT-dependent.

7. Existence value

The existence of a passenger transport network is considered to have a unifying impact on the areas served, thus contributing to integrating, rather than to isolating, communities and creating a sense of regional cohesion (Booz Allen Hamilton 2001; Bristow et al. 1990; WRC 2000). However it may be double-counting any amenity value. Other definitions make existence value as a variant of option value, wherein individuals are willing-to-pay for retaining resources irrespective of their expectations of future use.

8. Amenity value

Amenity values are defined in the Resource Management Act 1991 (RMA) as "those natural or physical qualities and characteristics of an area that contribute to people's appreciation of its pleasantness, aesthetic coherence, and cultural and recreational attributes" (s2 RMA). Increased traffic noise and congestion and reductions in safety are factors thought to impinge on urban amenity values (PCE 1997).

Amenity values associated with the presence of public transport in a community may be difficult to measure.

At the same time, certain types of public transport services, such as diesel buses (which may emit particulates and are noisy), may have negative amenity value impacts. Clearly, the positive and negative amenity values have to be taken into account in a full evaluation of the benefits of public transport.

Public transport may contribute to the amenity value of a residential area by improving the accessibility to services and shops within and beyond the area. Other amenity values, such as public view (visual impact) and open space protection, heritage and special character site protection, urban regeneration, and landscape values, are usually considered under 'intangible benefits' and, in New Zealand, have been incorporated in the current evaluation frameworks for ATR and Patronage Funding.

9. Altruistic value

A broader definition (Bristow et al. 1990) of an altruistic benefit is that derived by all non-public transport users in knowing that others in the community have access to public transport. It appears that altruistic benefits may double-count equity and option values. It may be measured as trips saved by individual drivers or, alternatively, it could be a willingness-to-pay measure.

2.4 Accessibility Benefits & Public Transport Evaluation Frameworks in New Zealand

Table 2.1 summarises the accessibility benefits and indicates whether or not they are included in the current ATR and Patronage Funding evaluation frameworks used for public transport in New Zealand. In addition, the benefit is distinguished either as a 'resource' or a 'transfer benefit' (see Table 2.1 notes for definitions).

Some resource benefits may result in measures that can be accounted for in measures used for another benefit, i.e. double-counting. The benefits listed in Table 2.1 that may be affected by double-counting include:

- Producer benefits;
- More efficient city and regional centres;
- Existence values.

Equity value benefits are transferable, and they may be taken up by the activities of other sectors of government. Therefore they are not considered further in Chapters 4 and 5 of this report.

The literature review (Chapter 3) has focused on the following accessibility benefits:

- More efficient public facilities (divided after the review into two categories);
- Producer benefits;
- More efficient city and regional centres;
- Increased opportunity for employment, education and other activities: not PT dependent ; PT dependent;
- Equity value (reviewed but not considered in later chapters of this report);
- Option value (non-users);
- Existence value;
- Amenity value;
- Altruistic value.

Table 2.1 Summary of Accessibility Benefits, their nature, and inclusion in current evaluation frameworks that are applied to public transport systems in New Zealand.

Key[1]	Type of Benefit	Currently incl. in ATR & PF	Resource or Transfer Benefit[2]	Beneficiaries
A	More efficient public facilities (includes economies of scale & reduced expenditure on services): 1. Reduced cost of serving population 2. More efficient location/design of public facilities	No	Resource	Community
B	Producer benefits (better choice of employees; greater retail and services sales)	No	Resource	Employers
C	More efficient city and regional centres (also known as economies of agglomeration)	No	Resource	Community
D1	Increased opportunity for employment, education & other activities (individual benefit) – not PT dependent	Yes	Resource	PT users, not PT dependent
D2	Increased opportunity for employment, education & other activities (individual benefit) – PT dependent	No	Resource	PT users, PT dependent
E	Equity value	No	Transfer	PT users, PT dependent
F	Option value-(non-users)	No	Resource	Non-users
G	Existence value	No	Resource	Community
H	Amenity value	No	Resource	Community
I	Altruistic value	No	Resource	Community

Definitions

[1] Letters A-I relate to descriptors used in Literature Review and subsequently in this report.

[2] *Resource Benefit* – one in which less real benefits (e.g. fares) are consumed.
Transfer Benefit – one which can be transferred between one party and another, with no change in real resources.

ATR – Alternatives to Roading (Transfund Manual 1997)
PF – Patronage Funding (Transfund Manual 2000)

3. Literature Review

3.1 Background

Chapter 2 raised a number of issues requiring further clarification and resolution in the next phase of this project, which was a full-scale review of literature available in New Zealand and overseas. In addition, consultation with other agencies and experts in the field was carried out. The intention was to confirm the definitions of mobility and accessibility established above and the subsequent categorisation of mobility and accessibility benefits. Whether or not the inclusion of a benefit in the evaluation framework is affected by (1) who receives the benefit and (2) the trip purpose, was also assessed.

With specific regard to accessibility benefits, the intention was to:

- Clarify the definitions;
- Confirm the nature of each benefit (i.e. transfer or resource benefit);
- Clarify who receives the benefit;
- Identify potential methods for measuring benefits and assess them for use in the New Zealand context;
- Comment on the values that have been derived elsewhere, particularly with reference to their use in the New Zealand setting.

The results are summarised by benefit type in Appendix 2, Literature Review Summary.

3.2 Results

The literature review generally confirmed the definitions and classifications of public transport accessibility benefits, with two main exceptions.

1. *More Efficient Public Facilities* could be better treated as two separate categories of benefits:
    - *Reduced Cost of Serving Population*, which refers to the cost reductions in (primarily) health and employment sector costs from providing accessible public transport for people with disabilities;
    - *More Effective Location/Design of Public Facilities* (e.g. education, medical) which come from centralising facilities at fewer larger centres because public transport services are available.
2. No evidence for a separate *Equity Value* benefit was found. It could be asserted that equity is concerned primarily with the distribution of benefits rather than being a separate benefit category. It was not considered further, and the literature review also did not identify any methods for measuring a separate equity benefit.

A significant feature of the international literature was its focus primarily on benefits for public transport-dependent people, with special attention on people with disabilities in relation to so-called 'cross-sector' benefits.

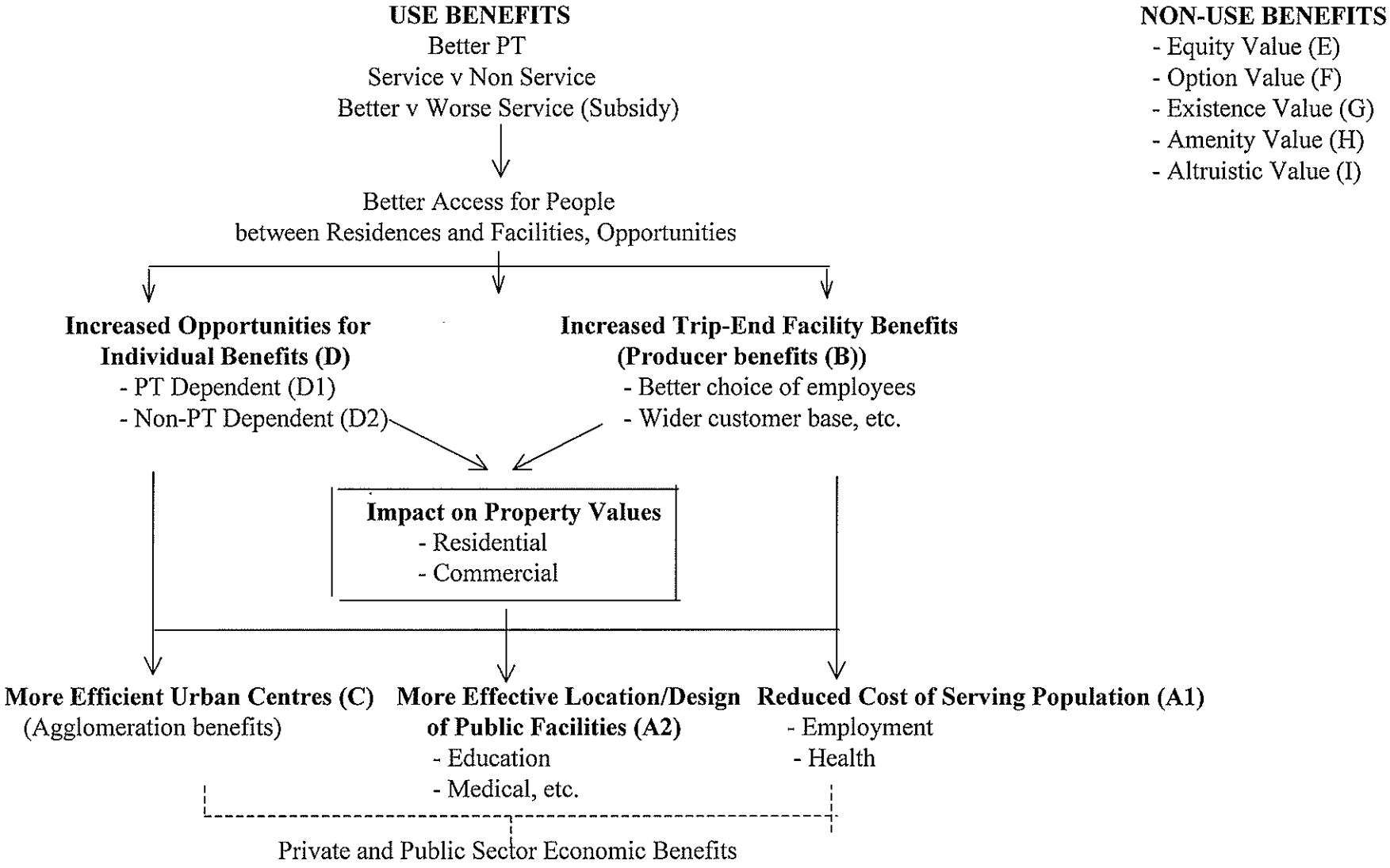
Figure 3.1 represents the accessibility benefits arising from the provision of public transport services. Several points should be noted:

- Benefits can essentially be divided into those which flow from use of public transport services, and those which are non-use benefits;
- Use benefits have an impact on property values, the extent of which reflects the value of the use benefit;
- Use benefits fall into two categories: person benefits; and private and public sector economic benefits.

Table 3.1 outlines the literature review results for each benefit type in respect of:

- Recipient Type – primarily whether the literature focuses on the transport-disadvantaged as the main recipients, or not.
- Trip Purpose – whether the literature differentiates benefit values by trip purpose.
- Impacts of Service v Subsidy – whether the literature focuses on the benefits from the public transport service(s) as a whole; or on benefit from the subsidy provided to support the services (at a level above a purely commercial service).
- Methodology – the methods proposed, and tested (where this has been done), to quantify the accessibility benefits from public transport services.
- Values – the actual benefit values derived for different benefit types.

Figure 3.1 Mobility/accessibility benefits of providing public transport services.



(See Table 2.1 for full list of benefit types A1 to I)

Table 3.1 Findings on effects of providing public transport services, obtained from the Literature Review.

Benefit Type		Recipient Type	Trip Purpose	Service v Subsidy	Methodology	Monetary Values
A	**More Efficient Public Facilities**				Review indicates that this type could be better treated in two categories of benefits, A1 and A2.	
A1	**Reduced Cost of Serving Population**	Focused on Transport Disadvantaged, especially people with disabilities. Also, focused on APT.	Medical & employment trips main focus; but other trip purposes also covered	Both services and subsidy (by assuming services reduced by certain %)	• User Survey Method (*Medical Trip Replacement* method): carry out survey of users of accessible public transport (APT) to estimate %/number of different types of medical trips/visits/services which can be avoided by APT. Then apply these rates to medical service costs to estimate cost saving (benefit) (Lund & Carr, TCRP Rep. 49, Easibus). • *Fiscal model* (Lewis & Williams) builds on User Survey method by developing model which estimates the fiscal impact on different health services of reducing PT funding. The model uses elasticities (wrt to funding and service) and assumptions about proportion of trips that go to welfare programmes. • *Employment benefit:* (Fowkes) - based on assumptions about % of adults with disabilities looking for work for whom APT would enable them to get to work (& currently now not able to do this), and % who would get jobs. Public cost savings equals savings in welfare benefits plus the income tax paid. • *Excess Unemployment Rate* (Booz Allen) - identified 'excess' unemployment rate of people with disabilities, and applied this rate to total number of people with a mobility handicap in the workforce Used Fowkes assumptions re % who would get employment through APT.	• Lund & Carr: net saving of £30,000 – 40,000 pa per 1,000 people was estimated. • Easibus: saving of €600,000 - €750,000 annually. • Lewis & Williams: estimated increases in health/social welfare program costs of $396M associated with a 10% ($650M) reduction in funding for low cost mobility programmes. • Fowkes: annual benefits of €256M to €1,161M, with employment benefits making up half of the estimated benefit. • Booz Allen: A$15-76M APT employment benefit for people with disabilities.

Benefit Type		Recipient Type	Trip Purpose	Service v Subsidy	Methodology	Monetary Values
A2	**More Efficient Location/Design of Public Facilities**	None specified	Education and medical, but others as well	Services	No methods actually developed and/or tested. Postulated that efficiency of different size institutions could be measured; or, a production function could be developed showing the different inputs needed to produce a given level of output (including public transport services).	None
B	**Producer benefits – better choice of employees; greater retail and services sales**	None specified	Work and retail	Services	• *Employer subsidy* (TCRP Rep 49 PDRTA) – amount employers are willing to subsidise transit services that show value to their enterprise. • *Hedonic Pricing of Commercial Property Values* for properties in vicinity of rail stations (FTA 2000).	FTA 2000: Parsons Brinckerhof: commercial properties within 1000 feet of a transit service station enjoyed premium values of $2.00 to $4.00 per square foot.
C	**More efficient city and regional centres (Agglomeration Benefits)**	None specified	None specified	Change in services	• *Multi-regression analysis* on urban areas, productivity and growth as dependent variables, presence of transit service is one explanatory variable. Coefficients become elasticities, and can be used to estimate impact of change in transit service on productivity and growth (FTA 2000).	FTA 2000: using coefficients from multi-regression analysis – a 1% increase in transit service presence gives $2.4 billion in annual productivity gains, $0.5 billion in additional economic growth (US).
D1	**Increased opportunity for employment, education & other activities (individual benefit) – not PT dependent**	Two UK user surveys ranked pensioners 1st for support	Work ranked 1st in these surveys, followed by shops, schools and medical facilities	Both full service, and changes in service level	• *Willingness-to-Pay surveys* (Bristow et al.) of users and non-users. • *Hedonic Pricing of Residential Property Values* for properties near rail stations. Note: all studies involve rail, i.e. not bus. Survey of users and previous users where level of service has been reduced *(PT Service Removal Impact* method) (ACT Transit, TCRP Rep.49). Identified income losses and added travel time.	• Bristow: users typically obtain a consumer surplus in the order of 100% of the fare • Hedonic pricing – a range of values for different situations. • AC Transit – annual costs of $48M, saving of $4.8M in operating costs.

Benefit Type		Recipient Type	Trip Purpose	Service v Subsidy	Methodology	Monetary Values
D2	**Increased opportunity for employment, education & other activities (individual benefit)** **- PT dependent**	Transport disadvantaged, especially unemployed and people without cars	Benefit values differentiated by trip purpose: work, medical, shopping etc.	Services and change in service	• *Consumer Surplus* - PT demand curve against fare level was estimated using knowledge of: total PT trips and average fare, average fare elasticity, and assuming higher fare elasticities at higher fares (based on high income elasticities of low income groups wrt taxi use). Area below demand curve and above total PT trip/average fare line taken as consumer surplus (Lewis & Williams). • User Survey and Value estimation by trip purpose – users surveyed to assess likely action if service is terminated, giving % of users who would not travel, use another mode, or get a ride with friend/relative. Value for missed trips determined depending on type of trip (e.g. medical trips by average medical claims, work trips by lost earnings). Costs of transport alternatives estimated. Benefits calculated. (TCRP Rep 49).	• Lewis & Williams - 1993 US national values calculated: $33.7 billion value for individuals from trips. • TCRP Rep 49 - different annual benefit values depending on case study.
E	**Equity value**	None	None	None	None (not considered further in this study).	None
F **G** **H** **I**	**Option value (non-users)** **Existence value** **Amenity value** **Altruistic value**	None	None	Service	• *Willingness-to-Pay surveys* (Bristow et al.) of users and non-users. • *Hedonic Pricing studies* – include these benefits for the areas involved.	

ATR – Alternatives to roadng evaluation system.
APT Accessible public transport
wrt – with respect to;

PT – public transport
$ - NZ$
€ euros
£ - pounds sterling

Methods discussed in Chapters 4 and 5, are in italics, e.g. *Medical Trip Replacement, Hedonic Pricing, Fiscal Model, Consumer Surplus, Multi-regression analysis, Willingness-to-pay survey, Employment and Production functions*

For more details, see Appendix 2 and the Bibliography.

4. Critique of Potential Methods for Estimating Public Transport Accessibility Benefits

4.1 Potential Methods

As a result of the findings from the literature review, the types of public transport accessibility benefits listed in Tables 2.1 and 3.1 are assessed in this Chapter 4.

The eleven potential methods for estimating accessibility benefits of public transport that were used by researchers listed in the literature review are shown in Tables 4.1 to 4.3 along with the public transport accessibility benefit types to which they apply.

Table 4.1 Potential methods for estimating public transport accessibility benefits.

Method	Description	Applicable Benefit Type
Medical Trip Replacement	Based on user surveys to identify medical home-visit replacement rates for accessible PT	A1
PT Service Removal Impact	Generally based on surveys of ex-users of terminated PT serivces to assess impact on access to employment, medical and other opportunities (can also be 'what-if' survey of current users)	D
Willingness-to-Pay for PT Survey	Carry out survey of users and non-users to ascertain their willingness to pay to retain a PT service	D, G, H, I
Fiscal Model	Aggregate model based on results of user surveys plus elasticities wrt to funding and services provided, and proportion of trips that divert to welfare programmes if PT is reduced	A1
Employment Function	Based on user surveys, to identify number of people with disabilities enabled to work because of accessible PT; and net public cost savings	A1
Efficiency Measurement	Measure efficiency of different sized institutions; and establish PT role in this	A2
Production Function	Develop production function showing the different inputs needed to produce a given level of output (including PT services)	A2
Employer Subsidy	Identify amount employers pay towards 'workers buses' to establish value of service to them	B
Hedonic Pricing – property values	Carry out multi-regression analysis with property value as dependent variable and proximity to rail station one of the independent variables	B, D, F
Multi-regression Analysis – urban areas	Carry out multi-regression analysis on urban areas, productivity and growth as dependent variables; presence of PT service is one explanatory variable	C
Consumer Surplus	Determine demand curve for PT trips against fare; area above line at average fare point and under curve is 'consumer surplus' and represents 'mobility benefit'	D

Table 4.2 Relationship of benefit types to methods of estimating public transport accessibility benefits of public transport to a community.

Benefit Type[1]	Method of Estimating Benefits[2]										
	1	2	3	4	5	6	7	8	9	10	11
A More efficient public facilities											
A1 Reduced cost of serving population	X			X	X						
A2 More efficient location/ design of public facilities						X	X				
B Producer benefits								X	X		
C More efficient city & regional centres										X	
D Increased opportunity for employment, etc.		X	X						X		X
E Equity value											
F Option value									X		
G Existence value			X								
H Amenity value			X								
I Altruistic value			X								

1 **A – I Benefit types** are those listed in Table 2.1

2 **1 – 11 Methods of estimating benefits** are those listed in Table 4.1

4.2 Selection of Methods

4.2.1 Selection Criteria

The criteria used to select methods of estimating public transport accessibility benefits to be considered as Stage 2 proposals were:

- *Theoretical Robustness* – does the method have a sound theoretical basis which is consistent with conventional economic theory? This was a pass/fail criterion in that methods which did not pass this criterion are dropped.
- *Experimental* – has the method been tested or is it still in the design/experimental stage? Methods which were experimental (Yes in Table 4.3) were considered carefully to decide if the results to date indicated they should be included.
- *Useful Results* – does the method provide useful results which can be simply converted into monetary values?
- *Widespread Applicability* – does the method produce results which can be transferred to other situations, or will the results be applicable only to a particular situation?
- *Data Requirements* – are the data required readily available, or does each application of the method require new data? Where methods require new data for each application, the method was not necessarily rejected; however, it could not be applied without a separate data gathering exercise.

4.2.2 Assessment

Table 4.3 presents an assessment of each of the methods, listed in Table 4.1, based on the above selection criteria (Section 4.2.1).

Table 4.3 Assessment of potential methods for estimating public transport benefits.

Method	Selection Criteria				
	Theoretical Robustness	Experimental	Useful Results	Widespread Applicability	Data Requirements
Medical Trip Replacement	Yes	No	Yes	Yes	Develops new data
PT Service Removal Impact	Yes	No	Yes	Depends on survey design	Develops new data
Willingness-to-Pay for PT Survey	Yes	No	Yes	Depends on survey design	Develops new data
Fiscal Model	Yes	Yes	Potentially	Yes	Mostly readily available, but requires some specialist data
Employment Function	Yes	Yes	Yes	Yes	Mostly readily available
Efficiency Measurement	Unproven	Yes	Possibly	Potentially	Substantial data gathering reqd
Production Function	Unproven	Yes	Possibly	Potentially	Substantial data gathering reqd
Employer Subsidy	Yes	No	Yes	Case specific	New data reqd
Hedonic Pricing – property values	Yes	No	Yes	Yes	New data reqd
Multi-regression Analysis – urban areas	Yes	Yes	Possibly	Yes	Mostly readily available
Consumer Surplus	Yes	Yes (for PT)	Yes	Yes	Data reqd about demand curve

On the basis of this assessment, of the methods listed in Table 4.3, the following meet the criteria:

- The **Medical Trip Replacement** approach has produced useful results (UK) and should be applicable in New Zealand (providing adequate data are available).

- The **Public Transport Service Removal Impact** approach has also produced useful results (primarily in the US). The main limitations on this approach are that the results may not be transferable to other situations (depends on survey design and sampling); and, it may be difficult to place a value on certain types of 'lost trips' (e.g. medical, leisure trips).

- The **Willingness-to-Pay for Public Transport Survey** approach has been applied to estimate option value for non-PT users and the consumer surplus for PT users. Allowing for the normal caveats with stated-preference type surveys, this approach can be said to be a proven benefit estimation method.

- The **Fiscal Model** approach is an aggregate model which involves several assumptions (seemingly based on US and UK data) about how public transport users will react to changes in funding changes to 'mobility programmes', and thereby service levels, including how many lost medical trips will go to 'Home Care' and how many lost work trips will result in unemployment. Thus, although the general approach could be applicable, as an aggregate model it relies on a number of assumptions that are untested in the New Zealand context. In addition, it is only applicable to the 'Reducing the Cost of Serving the Population' benefit which is also covered by several other methods.

- The **Employment Function** approach appears to produce useful results. However, it measures only the potential additional disability-employment benefits if a fully accessible public transport system was in place, rather than measure the benefits of the existing public transport system. This approach does not therefore fit within the scope of this research project.

- The **Efficiency Measurement** and **Production Function** methods should not be proceeded with given that they are unproven theoretically, are experimental, and may not give useful results.

- The **Employer Subsidy** approach produces case-specific results which relate to a particular service, and will not generally be useful in valuing the public transport accessibility benefits of an urban centre. In addition, few (if any) instances occur in New Zealand of employers subsidising public transport services.

- The **Hedonic Pricing** approach is a theoretically sound approach and has been widely applied (particularly in the US) with nearly all applications focused on rail systems. However, hedonic pricing should (in principle) also be applicable for bus systems, and this approach could be useful for New Zealand (where most of the public transport network in the urban centres is bus rather than rail). One limitation of the Hedonic Pricing approach is that it tends to group a number of benefit types, making it difficult to determine exactly which benefits are being measured.

- The **Multi-regression Analysis** of urban centres approach may be of limited usefulness in the New Zealand context given the relatively low number of centres with significant public transport networks.

- The **Consumer Surplus** approach is a theoretically sound approach which, although relatively new in regard to public transport accessibility benefits, is a proven economic approach.

Table 4.4 summarises the benefit estimation methods available by benefit type, and the application of these methods which was proposed for Stage 2 of the project (Chapter 5, Quantification of Public Transport Accessibility Benefits for New Zealand).

Table 4.4 Proposals for methods of estimating public transport benefits, to be applied in Stage 2 study.

Benefit Type		Benefit Estimation Method	Stage 2 Proposal
A	*More Efficient Public Facilities*	(divided into A1 & A2)	
A1	*Reduced Cost of Serving Population*	• Medical Trip Replacement[1]	• Use UK research results for visit replacement rates &, with NZ costs and usage data, to estimate A1 benefit for Total Mobility service.
		• Employment Function	• No proposal (does not measure existing service benefits).
A2	*More Efficient Location/Design of Public Facilities*	No methods developed to date	• None: no methods developed.
B	*Producer Benefits – better choice of employees; greater retail and services sales*	Hedonic Pricing	• None: new research required.
C	*More Efficient City & Regional Centres*	Multi-regression Analysis	• None: not enough cities to undertake multi-regression analysis.
D	*Increased Opportunity for Employment, Education & Other Activities (individual benefit)*	• PT Service Removal Impact	• Difficulties in valuing lost trips makes application of this method problematical.
D1	*- not PT dependent*	• Consumer Surplus	• Derive PT demand curve using Lewis & Williams' demand function equations, and estimate Consumer Surplus. Derived benefit will be primarily D2, but will include D1.
D2	*- PT dependent*		
F	*Option Value (non-users)*	Willingness-to-Pay Survey	None: new research required.
G	*Existence Value*	No methods developed to date.	None: no methods developed; may be included in Option Value.
H	*Amenity Value (associated with presence of PT in a community)*	No methods developed to date.	None: no methods developed; may be included in Option Value.
I	*Altruistic Value*	No methods developed to date.	None: no methods developed; may be included in Option Value.

1 Medical Trip Replacement approach could also be applied for other trip purposes (e.g. education); however, to date a methodology has been developed for only medical trips.

Note: Equity value (E) is not considered further in this study.

Further work on benefit quantification was proposed for two benefit types:

- Reduced Cost of Serving Population (A1), and
- Increased Opportunity for employment, education & other activities (individual benefit) (D).

The benefit types for which no further work was proposed fell into three categories:

- *No methods developed*: this category applies to More Efficient Location/Design of Public Facilities, Existence Value, Amenity Value, and Altruistic Value.

  The latter three benefit types may, however, be included in values obtained from user surveys examining Non-User Option Value (given the difficulty in differentiating between these benefits). It is likely that the values for these three benefit types would be relatively small.

- *New research required*: substantial new research would be required to develop New Zealand benefit values for Producer Benefits (measured using Hedonic Pricing) and Option Value.
- *Inadequate Data*: the Multi-Regression Analysis approach which has been used to estimate the benefits from public transport towards More Efficient City & Regional Centres cannot be applied in New Zealand on a cross-sectional basis (i.e. comparison of different cities) because of the small number of suitable centres for analysis. However, an analysis using both cross-sectional and longitudinal data could possibly be undertaken. Assembling this data set would be very time consuming (if the data were available). Our experience with other projects has been that longitudinal economic and transport-related data are very difficult to obtain. However, given the relatively large size of the postulated benefits for this benefit type, this estimation method should be considered as a potential area of new research.

4.3 Assessing the Impacts of Service v Subsidy

An important issue to be addressed is whether benefit estimates are to represent either the total benefits from existence of the public transport system, or the benefits of public funding (subsidy) to the system. Other New Zealand analyses (e.g. Subsidisation of Urban Transport Services; Patronage Funding project) have mostly focused on the benefits of greater or lesser levels of subsidy, rather than on the benefits of the total public transport system. Given that, in the absence of subsidy, some level of public transport service is likely to remain in at least the larger New Zealand centres, the incremental benefits of subsidy may be of most interest from the public funding viewpoint.

In addition, most planning decisions involve marginal changes in public transport service, so a benefit analysis method must be able to quantify these incremental impacts. (These are the incremental benefit of a marginal improvement in public transport service, or the incremental cost of a marginal reduction in public transport service.) Incremental benefits are certainly appropriate when assessing changes to the base system.

The benefit estimation methods fall into three groups:

- *Methods that can readily measure or directly derive the benefits of a change in service* (and hence subsidy): include methods involving user surveys, Multi-Regression Analysis, and Willingness-to-Pay Survey.
- *Methods that cannot be readily adapted to measure service change benefits* (and hence subsidy): include Employment Function, Hedonic Pricing.
- *Methods that can possibly be adapted to measure subsidy changes:* include Consumer Surplus. This could conceptually be applied to measure the benefit of subsidy by assessing the impact of increasing the fare level (so as to equate to removal of subsidy) on consumer surplus.

A more fundamental issue is whether the benefits covered by these methods are already covered by conventional benefit/cost analysis which could (in theory) be applied to public transport system changes (as is currently the case for Transfund's ATR and Patronage Funding schemes). A UK study (SACTRA 1998) which investigated the issue of accessibility benefits in regard to roading schemes, found that a 'fully specified' benefit/cost assessment should cover the majority of likely accessibility benefits.

However, when considering the public transport accessibility benefits identified in this project, certain community and non-user benefits would not be covered by the current ATR and Patronage Funding evaluation frameworks. These benefits include: More Efficient Public Facilities, More Efficient City & Regional Centres, Option Value, Existence Value, Amenity Value, and Altruistic Value.

5. Quantification of Public Transport Accessibility Benefits for New Zealand

5.1 Indicative Estimates

The value of different public transport accessibility benefits derived from an 'exploratory' application of the methods identified in Chapter 4 can be estimated using the values obtained from international studies. Table 5.1 presents these indicative estimates. As indicated in Chapter 4, some of these methods are not directly applicable to the New Zealand context. However, the indicative values in Table 5.1 provide a guide as to the likely relative size of different benefit types.

The total (indicative) annual benefit for the accessibility benefits identified is NZ$329M–$683M. This is mostly made up of the Increased Opportunities for Public Transport Users with $88M–$412M, Option Value for Non-Users with $133M, and More Efficient City & Regional Centres with $75M. Indicative benefit values cannot be estimated for a number of benefit types because of the lack of identified methods and benefit values. However, these latter benefits are likely to be captured within several of the other benefit types (due to the manner in which they have been measured).

Table 5.1 Potential methods for estimation of public transport accessibility benefits, and their indicative values (NZ$, at 2001).

Benefit Type		Basis for Indicative Estimate (Reference)	Current Indicative Annual Estimates-
A	*More Efficient Public Facilities*		
A1	*Reduced Cost of Serving Population:* • Medical • Employment	• Lund & Carr (1994) • Fowkes (1994)/ Booz Allen (1998b)	$27-36M for accessible PT (APT) system $1-1.4M for Total Mobility $3.4-17M for APT
A2	*More Efficient Location/Design of Public Facilities*	No methods developed to date	Not available
B	*Producer Benefits – better choice of employees; greater retail and services sales*	Various US Hedonic pricing rail studies	$1.6-9.8M for Wgtn Rail
C	*More Efficient City & Regional Centres*	FTA (2000)	$75M
D	*Increased Opportunity – for employment, education & other activities (individual benefit)*	Lewis & Williams (1999) Consumer Surplus analysis	$88-412M
F	*Option Value (non-users)*	Willingness-to-Pay Survey	$133M
G	*Existence Value*		Not available
H	*Amenity Value associated with presence of PT in a community*		Not available
I	*Altruistic Value*		Not available

5.2 Stage 2 Analysis

As indicated in Chapter 4, further analysis was undertaken for the following two methods of benefit estimation, to attempt to apply them to New Zealand data:

Method	Benefit Types
Medical Trip Replacement (Lund & Carr)	Reduced Cost of Serving Population
Consumer Surplus (Lewis & Williams)	Increased opportunity for employment, education & other activities (individual benefit)

The analysis carried out, and the results achieved for these two methods, are reported in Sections 5.3 and 5.4 respectively.

5.3 Medical Trip Replacement

5.3.1 Overview

This method aimed to estimate the value of the Reduced Cost of Serving Population benefit related to medical trips. It is based on the approach developed by MVA (cited in Lund & Carr 1994). Essentially the MVA method involved identifying the replacement rates (from user surveys) for domiciliary visits which would be replaced by visits to the health care worker's premises using accessible public transport, and applying these replacement rates to data on the number and cost of these visits. This is then compared with the cost of providing the accessible public transport service.

The MVA approach was modified for this project to be applied to users of the Total Mobility service. The MVA visit replacement rates were to be used in lieu of New Zealand specific rates.

5.3.2 Information Required

The information required to undertake this analysis was:

- Total number of Total Mobility service users;
- Total number of domiciliary visits received by Total Mobility service users;
- UK replacement visit rates used to estimate the additional number of domiciliary visits required if Total Mobility is not available (by working backwards);
- Costs of domiciliary services on a per visit basis;
- Costs of Total Mobility service (and accessible public transport service) on a per trip basis.

5.3.3 Information Obtainable in New Zealand

An extensive effort was made to collect the data set out above. However, progress was stalled by the lack of useful information. Some information, such as total number of Total Mobility passenger boardings per annum and the subsidy rate per trip, was readily available. Other data are simply not collected in New Zealand, for reasons listed below:

- The only means of determining the actual number of Total Mobility service users is to contact Regional Councils individually and request the number of users registered in their area.
- No data is collected on Total Mobility trip purposes, as it is assumed that the consumer (who pays half the cost of each trip) is using it for their highest valued trips. A Total Mobility Scheme review was conducted in 1993 and incorporated a user survey that included some information on trip purposes, but the research team has been unable to obtain a copy of this report.
- Total number of domiciliary visits by type is simply not collected in the New Zealand context. This is because many domiciliary care services are contracted out to private providers through individual District Health Boards (which were formerly the Health Funding Authority). These contracts do not necessarily specify number of visits to recipients. The private providers themselves have quite likely determined the costs of domiciliary visits and determined volumes in order to negotiate with the funding agency, but this information is generally regarded as commercially confidential.
- The Ministry of Health published a report on health expenditure for 1980-1999 that included total expenditure on Disability Support Services and Community Care (a mix of domiciliary and centre-based services). Again there is no indication of the actual number of visits undertaken. In addition, the methodology associated with the data collected for the report has been severely questioned, particularly with respect to these two areas.
- The Household Disability Survey 1996/97 collected extensive information on home help with domestic tasks (i.e. help required for shopping, housework, personal care, heavy work, etc.) but only quite general information on any medical treatment received in the previous 12 months. Again, information on the number of home-based visits is not collected.
- Because the total number of visits is unknown, estimating the cost per visit is very difficult (even ignoring the questionable dollar figures available).
- Estimating the potential of the Total Mobility scheme and/or accessible passenger transport to replace domiciliary visits is also somewhat confounded, in the New Zealand context, by the fact that several other players are assisting with the transport needs of disabled people. For example, the Ministry of Health and Lotto Fund have retro-fitted private vehicles for use by the disabled, and the Ministry of Health provides travel and accommodation allowances to ensure that clients can get to treatment sessions. The latter are available to anyone with need, but definitely include some disabled clients.

5.3.4 Conclusions

Our earlier literature review yielded evidence of potentially significant benefits in relieving the demand for health and welfare services to be offered in the home by providing accessible public transport services for disabled people. While the Transport Research Laboratory study (Lund & Carr 1994) did not find that existing accessible public transport services were replacing domiciliary visits to any significant extent, New Zealand-based evidence lends support to the concept. For

example, the case study of the withdrawal of urban bus services in Tauranga (Perrins 1986) found that, once the services were withdrawn, people made fewer visits to the doctor or specialist services at the hospital and in some cases were unable to visit at all. A later survey of transport-dependent people in New Zealand (Booz Allen Hamilton 1998b) found that some people would suffer severe inconvenience in doing personal business (including visiting health practitioners) if public transport services were removed or curtailed.

Based on methodologies and data developed in the UK (Lund & Carr 1994), an estimate of the benefits of reduced cost of serving the population could be NZ$27M–$36M for an accessible passenger transport system or $1M–$1.4M for the existing Total Mobility service. Unfortunately, the lack of information in New Zealand described in Section 5.3.3 meant that this estimate could not be improved on using New Zealand figures.

5.4 Consumer Surplus

5.4.1 Methodology

This methodology assesses the net benefits that travellers experience from using public transport for their trips. These benefits may be referred to as accessibility (or access) benefits, but represent net aggregate user benefits as perceived by travellers. These 'consumer surplus' benefits reflect the price that travellers would be willing to pay to use public transport for their trips, over and above their 'generalised cost' (including fares paid) for the trip.

The methodology is based on that used by Lewis & Williams (1999) for assessing 'low cost mobility' benefits, but adjusted and calibrated to the New Zealand situation.

The demand curve for the use of local public transport services in New Zealand is shown (indicatively) in Figure 5.1. Key features are as follows:

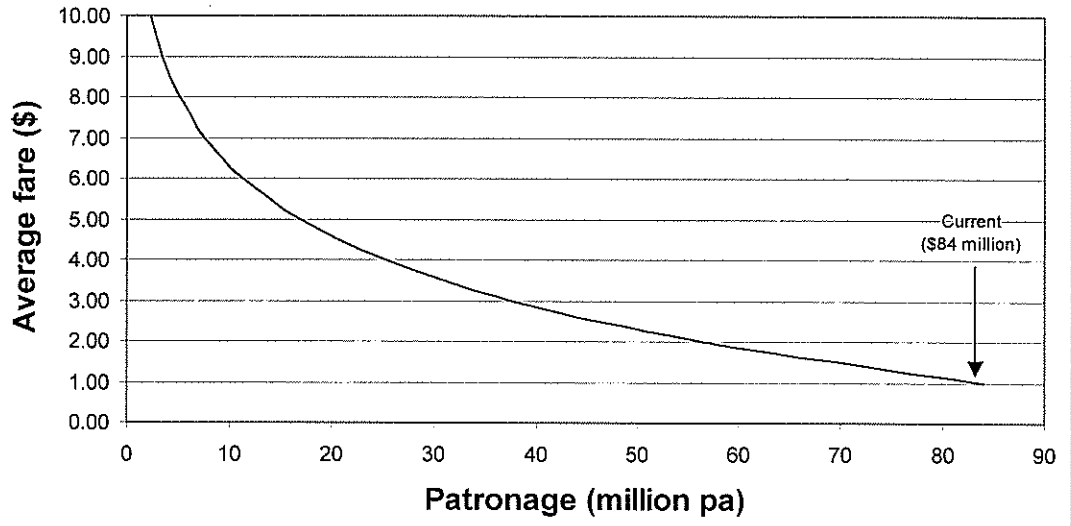
(i) Demand Curve $T = f(F)$
where: T = total patronage
F = fare

(ii) Existing situation defined by:
Average fare $(F) = \$1.00$
Total patronage $(T) = 84$ million pa
Elasticity $(\eta) = -0.4$ (typical NZ short/medium-term value).

(iii) Fare elasticity (η) function defined by:

$$\eta = \frac{(dT/T)}{(dF/F)}$$

Figure 5.1 Demand curve for patronage (million passengers per annum) v average fare ($NZ).



(iv) Fare elasticity taken as proportional to fare level, i.e.:

$$\eta = bF \text{ (b = constant)}$$

This is consistent with Lewis & Williams methodology, and with recent Booz Allen Hamilton review of international evidence.

Mathematical analysis from the above relationships then gives the following:

$$\eta = bF = \left(dT/T\right)\left(F/dF\right)$$

$$dT/dF = bT \text{ or } dT/T = bdF$$

$$\ln T = bF + c \qquad (c = \text{constant})$$

$$T = e^{bF}e^{c} = ke^{bF} \quad (k = e^{c} = \text{constant})$$

Consumer surplus (CS) (area between demand curve and price paid) is calculated as:

$$CS = \int_{Fo}^{Fi} TdF = \frac{1}{b}\int_{To}^{Ti} dT = \frac{1}{b}(T_i - T_o)$$

$$= k/b\left(e^{bFi} - e^{bFo}\right),$$

where F_i = assessed maximum willingness-to-pay by passengers
T_i = corresponding number of passengers at that fare.

The constants (b, k) are derived as follows:

$$b = \frac{\eta_o}{F_o} = \frac{-0.4}{1.0} = -0.4$$

$$c = lnT_o - bF_o - ln(84) + 0.4 = 4.831$$

$$k = e^c = e^{4.831} = 125.31$$

$$\text{hence CS} = \frac{125.31}{0.4}\left(e^{-0.4} - e^{bF_i}\right)$$

5.4.2 Results

Table 5.2 following gives values of T_i (patronage in passenger numbers per annum) and CS_i, (Consumer Surplus in \$NZM pa) for different values of maximum willingness-to-pay by passengers F_i.(\$NZ).

Table 5.2 Consumer surplus and patronage v maximum Willingness-to-Pay.

Max. Willingness to Pay (F_i) (\$NZ)	Patronage (T_i) (million passengers pa)	Consumer Surplus (CS_i) (\$NZ million pa)
1 (existing fare)	84.0	–
2	56.3	69.2
3	37.7	115.6
4	25.3	146.8
5	17.0	167.6
6	11.4	181.6
7	7.6	190.9
8	5.1	197.2
9	3.4	201.4
10	2.3	204.3

The results indicate the following:

- The elasticity function is such that the remaining number of public transport trips diminishes rapidly as the fare increases: at an average fare of \$5 (5 times the existing fare), only about 20% PT trips remain; whereas at \$10 only about 3% remain.
- However, the total consumer surplus value is not very sensitive to the precise maximum willingness-to-pay (WTP). At a maximum WTP (fare) of \$10, the total consumer surplus is some \$204M pa; and is still within 10% of this at a maximum WTP of \$6.50.

In any estimate of total consumer surplus benefits associated with the public transport system, it is desirable to assume a maximum WTP value. This reflects that, in practice, if such high fares were imposed travellers would most likely choose to

travel by taxi, or acquire a car. The consumer surplus benefits can therefore be easily calculated (roughly) if estimates of average transit and taxi fares per passenger-kilometre are available.

A maximum value in the range $6 – S10 would seem reasonable for this purpose, for a trip of average length (around 6-8 km for PT trips), given typical taxi fares. But, as noted, the consumer surplus results are not sensitive to the precise assumptions adopted regarding maximum value and average trip length.

5.4.3 Conclusions

Hence we conclude that the accessibility benefits associated with use of the local public transport system in New Zealand are about $200M pa.
This represents:

- about $2.40 per current trip,
- a worth of about $53 per New Zealander,
- about 2.4 times the current average fare,
- about 2.4 times the existing subsidy levels.

For their study in the US, Lewis & Williams gave estimates for:

- A total consumer surplus averages US$4.68 per current trip
- Total consumer surplus represents about 2.1 times net public expenditure on US transit systems.

Factors influencing the higher average consumer surplus estimates for the US include the lower elasticity assumed (average elasticity of –0.3 for the existing situation) and the higher current average fare (i.e. US$1.50).

6. Next Steps

6.1 Benefit Estimation Research

A number of public transport accessibility benefit types exist for which an indicative benefit quantification (Table 6.1) suggests that a substantial dollar value can be obtained if they were to be applied to public transport systems in New Zealand. However, it has not been possible within this research project to quantify their benefits for New Zealand because of the lack of information publicly available. The benefit types which warrant further research to facilitate their quantification are listed in Table 6.1, along with the applicable benefit estimation methods.

Table 6.1 Further research required to facilitate quantification of public transport accessibility benefits.

Benefit Type		Benefit Estimation Method	Comments
A1	Reduced Cost of Serving Population, e.g. Medical Trips	Survey of Total Mobility (TM) Users and Domiciliary Service providers	Identify likely number of additional domiciliary visits required if TM service withdrawn. Also need to identify domiciliary service cost.
A2	Reduced Cost of Serving Population, e.g. Employment Trips	Survey of Total Mobility Users	Identify employment 'losses' likely to result from TM service withdrawal. Also need to address issue of 'job displacement' (i.e. extent to which disabled people-jobs are new jobs).
B	Producer Benefits	Hedonic Pricing and Willingness-to-Pay (WTP) survey of employers	Success of hedonic pricing research will depend on data availability. Also need to identify any 'double-counting' (i.e. extent to which these benefits are covered by other PT accessibility benefits).
C	More Efficient Cities & Regional Centres	Multi-regression analysis	Would require longitudinal data for major PT cities (Auckland, Wellington, Christchurch).
F	Option Value	Willingness-to-Pay survey(s)	WTP surveys in 3 major PT cities to identify amount users and non-users WTP to retain a PT service (i.e. irrespective of level of personal use).

Of the benefit types listed in Table 6.1, Option Value and More Efficient Cities & Regional Centres are likely to provide the highest benefit values (indicative estimates of $133M and $75M respectively, in Table 5.1). These should therefore be the highest priority research areas of those listed. Given the likely difficulty in obtaining adequate data for the method for estimating More Efficient Cities & Regional Centres, research into quantification of Option Value may be more successful.

6.2 System Changes

As discussed above, most of the benefit estimation methods available do not lend themselves well to quantification of system changes. Therefore the need is for research into adapting existing methods in order to value these system changes, and for an examination of possible new methods which can do this.

Appendix 1 Public Transport Mobility Benefits Thinkpiece

A1.1 Setting the Scene

The social goals of government often encompass the desire to ensure that all citizens have (equal) opportunity to access essential and other social, cultural, and recreational services in their region. Essential services may encompass medical-, educational- and employment-related services, as well as more basic needs such as food and housing. Government equity objectives are generally focused on income redistribution, such that those who are less well off are made better off by favourable public policies and subsidies. In the transport sector, governments may provide subsidies for specific groups of people who are thought to be transport disadvantaged and/or provide passenger transport services for their use in an effort to reduce inequalities in access.

The New Zealand Government has clearly indicated its goal of equal opportunity for access for all New Zealanders. In February 2000, it released a document entitled *Key Government Goals to Guide Public Sector Policy and Performance* in which one of the goals is to "grow an inclusive, innovative economy for the benefit of all". The document emphasises that this type of economy adapts to change, provides opportunities and increases employment and income as well as "closing the gaps" between different groups in society. The *Ministry of Transport Strategic Plan 2001 – 2006*, in elaborating on the *Key Government Goals* states "mobility is a fundamental need for citizens to participate in society. Accessibility impacts on individual's ability to manage their lives". To achieve the Ministry goal of a sustainable transport system, the *Plan* identifies three objectives specifically related to accessibility and mobility:

1.2 Improve levels of accessibility for public transport services.
1.3 Improve transport's contribution to reducing inequalities.
1.5 Advance New Zealand's interests in and access to the global transport system.

The goal of a sustainable transport system can be put into context by referring to the international literature. For example, Litman (1999) suggests that a sustainable transport system implies that:

- The focus of the transport system is improving accessibility rather than mobility.
- Each mode of transport is used for what it does best, and typically involves a reduction in private car use.
- Individual transport planning decisions are "subordinate" to the community's long-term planning objectives.

Litman (1999) goes on to state that sustainable transportation incorporates the need to take into account the long-term impacts of transport and land use patterns, with a particular regard to avoiding situations that create or perpetuate "automobile dependency". Automobile dependency is seen as unsustainable because it involves an "excessive" consumption of resources, in terms of energy, time, money and so on.

So, how does providing public transport services assist in the pursuit of a goal of sustainable transport and a sustainable economy? Litman concludes (p.11) "sustainable development requires significant changes in our transportation system to increase economic efficiency, equity and environmental security".

In recent times, the New Zealand Government has addressed its equity objective, in transport, primarily through its "social services output class" which includes the concession fares and other provisions for the "transport disadvantaged". While the Government has financially assisted the provision of public transport services and infrastructure, the principle benefits explicitly acknowledged in such funding have been related to congestion relief, accident reduction, and improved environmental quality.

The Government makes its new investment decisions about public transport funding using two separate (but linked) frameworks. The benefits valued in these frameworks tend to be those known as 'efficiency' benefits, including travel time savings, accident reduction and vehicle-operating cost savings. Various groups within New Zealand society have argued that the Government should also recognise and account for the benefits related to improvements in accessibility and mobility in its decisions to fund passenger transport services and infrastructure.

This Thinkpiece addresses the complex issues surrounding this argument. Section A1.2 outlines some views on the concepts of mobility and accessibility and derives a definition for both terms to be used throughout this project. Section A1.3 discusses the benefits associated with mobility and accessibility and some means of categorising them. Section A1.4 looks at who receives any mobility and accessibility benefits of providing passenger transport services. Section A1.5 briefly looks at some methods for measuring the benefits identified in the previous sections to be relevant. The final section A1.6 identifies issues that need further consideration in the literature review which is part of Stage 1 of the project. The Literature Review is summarised in Appendix 2.

A1.2 Mobility or Accessibility: What is the Objective?

'Accessibility' is generally accepted to refer to the ability to obtain desired goods and services,and the ability to reach desired activities and destinations. However, the meaning of 'mobility' is not so clearly defined as it sometimes refers simply to physical movement and at other times appears to have a definition similar to accessibility.

Accessibility and mobility can be viewed from several perspectives, including:

- A particular location (for example, how accessible a work site is to non-drivers, and the quantity and types of mobility required for commuting to it by employees).
- A particular type of service or activity, such as the accessibility of medical clinics to their clients.
- A particular group or person (e.g. how mobile is a particular person or group).

When determining the government's goal in funding public transport services, conflicting arguments are proffered that support either accessibility or mobility. The following sections examine these views in order to derive a position for this project. At the same time, we will clarify the definitions of the concepts of accessibility and mobility, because they will be used for the rest of this research undertaking.

A1.2.1 Some Views on Mobility

How do mobility and accessibility contribute to a government's equity objective of equal access for all citizens to essential services? The key concept appears to be access, yet the loss of mobility often contributes directly to a loss of access. For example, Perrins (1988) reported on a survey of former bus users' responses to the withdrawal of most bus services in Tauranga in 1986. She found that many former users had suffered inconvenience, and most considered themselves worse off financially and in other terms. A small number had experienced severe hardship as they had lost access to employment or had to change their work hours (10%), lost access to essential services (21% were no longer able to visit a doctor or hospital), and to leisure and recreational pursuits.

Many have argued for a focus on mobility, stating that 'mobility' should be considered a basic human "right":

> *People are born almost equally mobile. Their natural mobility speaks for the personal liberty of each to go where he or she wants. Equity demands the protection of this right against any abridgement. For the sake of this protection it is irrelevant to ask by which means a person's mobility is threatened* (Illich 1973, as quoted by Sergejew 2000).

Sergejew (2000) argues that the "right of mobility has been a common law right for centuries", although he notes that the degree of mobility required has not been defined, particularly for those with limited personal mobility.

Litman (1999) maintains that "vehicle travel is now required to participate in many economic, social and community activities" and, citing other sources, that mobility is considered "essential" or a "right" because of its importance to economic and personal development. Litman asserts that mobility can be conceived of as a merit good, specifically with reference to mobility which provides access to locations and activities of high value to society such as education, employment and essential services, using the most cost-effective travel option. He labels this as "basic mobility", i.e. the "minimal level of mobility or access that individuals need and deserve to function in society".

Lewis & Williams (1999) studied the relationships and interdependencies between the level of mobility and quality of life (standard of living) of individuals. They came to the strong conclusion that individual mobility levels influence the quality of life experience, commenting "access to mobility becomes not only important, but necessary in securing an acceptable standard of living" (p. 146). They also stated that "basic mobility" is a merit good and entitles individuals to a "minimum standard of transport provision." They also advocated that mobility expenditure from the public purse should be allocated on the concept of need rather than only on the basis of

effective demand (i.e. potential ridership), since mobility for people with greater needs may deserve more public support than others.

Others warn that improved mobility can be both positive and negative (Ross 2000; Salomon & Mokhtarian 1998; Cervero 1996). Handy (1994) observes that good mobility does not equate to good accessibility, although it is a contributor, while Ross (2000) posits "accessibility is the ultimate aim of mobility". Handy (1994) declares that "increased mobility may be a good thing, higher levels of accessibility are inherently a good thing". At a community level, increased mobility may indicate reduced accessibility as more dispersed land use patterns force people to travel more to gain access.

Ross (2000) notes that, while mobility is often presented as the basis of prosperity or as important to freedom and choice, by itself mobility, particularly involving private motor vehicles, "contributes nothing to wealth, can be wasteful of resources, damages communities, and contributes to air, water and noise pollution". Salomon & Mokhtarian (1998) echo this, calling mobility a "mixed blessing" as particular forms of mobility (e.g. private car, bus, bicycle) may be personally efficient and hence contribute to social benefit by improving social welfare, but if, at the same time, mobility generates sufficient externalities, then it may be socially inefficient.

Ross (2000) defines mobility as "movement" or even as "amount of movement" and is specifically referring to mobility using a private car. He suggests that mobility can be measured, at a societal level, in terms of "vehicle kilometres travelled" while personal mobility can be measured as the "per capita vehicle kilometres travelled". Neither the definitions nor the measures provide any indication of the ability of people within the community to access services. He does argue, however, that reducing car use and restricting personal mobility (i.e. reducing vehicle kilometres travelled) would help to increase accessibility.

By contrast, Suen & Mitchell's (2000) definition of mobility is focused on having transport services meeting the needs of users, in terms of destinations, information and physical and financial access. For example by:

- having transport services going where and when one wants to travel;
- being informed about the services;
- knowing how to use them;
- being able to use them; and
- having the means to pay for them.

This definition can be viewed as an expanded version of the concept of 'basic mobility' (Litman 1999, Lewis & Williams 1999) discussed above, namely the minimum level of transport provision that people need to function in society.

A1.2.2 Some Views on Accessibility

In the late 1980s, the Royal Commission on Social Policy declared that accessibility is a basic human right, rather than mobility:

> *People have a* right to access *necessary services and facilities. If their circumstances (income, age, disability) make it difficult for them to provide for their own needs and/or utilise existing services (if there are any) then there is a duty on public authorities to assist* (roman type *added,* Good 1988, quoted in Sergejew 2000).

Handy (1994) argues that government policy should focus on accessibility as this will lead to a focus on city development as a whole, rather than just the transportation network. Accessibility objectives recognise that transport systems and networks exist to satisfy society's needs for access to places, rather than as an end in themselves (Cervero 1996).

Ross (2000) defines accessibility as the "ease of access to destinations" and states that as such, it is the inverse of mobility, which he defines as being the amount of travel people undertake by car. He argues that higher vehicle kilometres travelled mean less accessibility as people are expending more effort to reach their destination. Ross suggests that measures of accessibility may include real or perceived costs in terms of time or money, distance travelled, comfort, availability and reliability of public transport or some combination of these.

The concept of accessibility does not necessarily incorporate movement, or mobility, as access can be by other means such as telecommunications, alternate work schedules or the internet. Thus, accessibility is a measure of supply, that is potential mobility, and not a descriptor of behaviour (Salomon & Mokhtarian 1998). Accessibility is determined by the spatial distribution of potential destinations, the ease of reaching them, and the magnitude, quality and character of activities found there (Handy 1994).

From a social perspective, travel costs are important too, as less expensive travel equates to greater accessibility, particularly for those with limited financial means. Having a choice of modes also improves accessibility, as more options are available and usually more opportunities to go there (although having two competing bus services operating on the same timetable will not create more opportunities, simply more choice). Handy (1994) also considers that having a choice of more and varied destinations, rather than one or two, enhances accessibility.

A1.2.3 Choosing between Accessibility & Mobility as a Policy Objective

What does this mean in the context of Government's goal in funding passenger transport? From the preceding discussion we can conclude:

- Mobility is only one means to accessibility, albeit an important one, where the loss of a mobility option often leads to the loss of access.
- Governments generally try to improve equity for their citizens, and one area they particularly focus on is equity of access to essential services.
- The primary purpose of mobility is to gain access. Almost without exception, the definitions of mobility cited above include some reference to access or accessibility. Mobility for mobility's sake is not a socially desired outcome.

- The primary purpose of accessibility is to ensure that all members of society have the ability to meet their needs for a basic quality of life.
- Improved mobility may not be the best choice to improve access.

Clearly then, improving accessibility, rather than mobility, should be a primary policy goal for Government in funding passenger transport to achieve its social equity objectives[1]. Some types of access are clearly going to be more important to society than others, and public support will be focused on them. Examples include access to medical services, education, employment, shopping for basic needs such as food, and a reasonable level of social and recreational activities.

For the purposes of this project, 'accessibility' is defined as:

the ability and ease of all members of society to obtain the goods, services and activities required for a reasonable quality of life.

Following on from this, 'mobility' is defined as:

the ability and ease of individuals to move or travel in the greater community.

In the case of passenger transport, improving or providing mobility is its primary contribution in assisting the government to achieve accessibility goals.

Following these conclusions, a number of points remain unclear:

- What are the specific benefits attributed to accessibility and mobility?
- Who receives these benefits? Are benefits confined to a particular trip purpose or person type?
- Should the system-wide benefits be calculated or only those related to subsidy provision?

An understanding of these issues is critical if the New Zealand Government is to recognise and account for such benefits when making decisions about funding public transport services and infrastructure. The following Section A1.3 of this Appendix addresses these matters.

A1.3 Types of Benefits Associated with Accessibility & Mobility

Using the definitions derived for this study, the primary benefit of improved mobility, associated with funding public transport services, is stated to be improved/better accessibility. A potential categorisation of the specific benefits associated with improved accessibility and mobility benefits associated with public transport is outlined below.

Efficiency benefits are a very important component of the total benefits associated with public transport, and are well documented in the literature and accounted for in

[1] Other policy objectives include economic efficiency, improved safety outcomes and improved environmental quality. Discussion of these objectives is beyond the purview of this paper.

evaluation frameworks used in New Zealand. They are discussed briefly in this Section A1.3 to put accessibility and mobility benefits into a New Zealand context.

A1.3.1 Nature of Public Transport Benefits

Litman (1996) states that benefits of public transport may be considered in two main categories:

- **Mobility benefits**, resulting from increased travel choices, particularly for people who cannot own or drive a personal automobile. Since non-drivers tend to be economically, physically and socially disadvantaged compared with drivers, this also increases equity.
- **Efficiency benefits**, which result from reduced car use. This includes PT-user savings, congestion reduction, travel time and vehicle-operating cost (VOC) savings for road and public transport users, parking cost savings, reduced accidents benefits, and a variety of environmental benefits. This category includes Intangible benefits, which are defined as external benefits (or disbenefits) affecting the surrounding environment, but not having a monetary value.

Unfortunately, Litman's classification tends to mix together what we have called 'accessibility' and 'mobility' benefits, although his primary focus is on accessibility benefits. For the purposes of this project, these two kinds of benefits are considered separately.

Another common method of categorising benefits is according to whom receives the benefit or disbenefit under consideration, e.g. public transport user benefits and non-user benefits.

A1.3.1.1 *Nature of Mobility Benefits*

Based on the definition of mobility used in this project, mobility benefits are limited to public transport user benefits, such as:

- Physical accessibility to those who have difficulty with transport (e.g. low floor buses, stops close to home and destination).
- Access to places where people want to go (routing), when they want to go (frequency, timing of services).
- Improvements in 'soft' variables, such as comfort, cleanliness, quality and appearance of stations/stops, attitude and appearance of personnel, information availability and quality, etc.
- Private resource-cost savings related to reduced private vehicle use (fuel costs, insurance, maintenance, depreciation), and possibly elimination of need to purchase or own a car (the latter is also known as an 'opportunity value' of public transport). Litman (1999) denotes this benefit as 'financial savings' arising from having a greater choice of transport options.
- Improvements in walking, waiting, in-vehicle travel and exiting times. These contribute to the cost savings of reduced private vehicle use and potential opportunity benefit.

- 'Users' economies of scale' (or the Mohring effect) in which each additional public transport user improves the service level as it creates a demand for better service frequencies and quality. Users' economies of scale are a benefit that applies to existing public transport users as a group rather than to individuals.

Some of these benefits are recognised as 'efficiency benefits', resulting in reduced car use, and are already accounted for by Transfund, on behalf of the New Zealand Government, in evaluating public transport options for funding. These include improvements in walking, waiting, in-vehicle travel, and exiting times; reduced private resource costs (such as VOC savings). Transfund's evaluation procedures also incorporate improvements in soft variables. User economies of scale are generally accounted for in the valuation of public transport user benefits of service frequency, travel time savings, and service quality improvements. The remaining mobility benefits (better physical access to transport and improved opportunities from better access) can also be considered as accessibility benefits, which is what we do in this project.

Given the above discussion, mobility benefits will not be further addressed in this project as a separate type of benefits; and the project will focus on accessibility benefits.

A1.3.1.2 *Types of Accessibility Benefits*

Litman (1999) defined four kinds of what we have termed 'accessibility' benefits associated with public transport:

1. **Economic development benefits** – benefits to society as a whole of increased productivity and employment. These are largely comprised of cross-sector benefits (Lewis & Williams 1999). Cross-sector benefits accrue to other sectors of the economy as a result of expenditure on public transport.

2. **Personal benefits** – benefits to users arising from increased employment, education, recreation and social activities.

3. **Equity benefits** – benefits, to both users and society, of providing mobility to people who are economically, socially or physically disadvantaged.

4. **Option value benefits** – benefits to society from maintaining transport options in case of changes in individual or social needs.

Other potential accessibility benefits identified in the literature include amenity values, cohesion/social integration, existence value, indirect and altruistic benefits.

A1.3.1.3 *A Categorisation of Public Transport Benefits*

Table A1.1 identifies the potential benefits associated with public transport by the category types outlined above, namely accessibility, efficiency and intangible benefits. As discussed, mobility benefits have been subsumed within the efficiency and accessibility categories of benefits.

No attempt has been made at this stage to identify any overlapping or double counting of benefits; and this is merely a reference list of all potential benefits. The various types of Accessibility Benefits (column 3) and their relationship to other types of benefits are discussed individually below (Sections A1.3.2 – A1.3.8).

Table A1.1 Potential benefits associated with public transport provision.

Efficiency Benefits	Intangible Benefits	Accessibility Benefits
Travel time savings* (including access, egress, walk, in-vehicle time) – both PT users and non-PT users	Special areas	Economic – social (including cross-sector)
Private resource cost savings* (incl. VOC) – both public transport users and non-users	Ecological impact	Economic – personal; also called opportunity benefits*
Roading maintenance / construction savings	Visual impacts	Improved accessibility/ opportunity, including better physical access to PT*
Accident reduction benefits	Community severance	Equity value
Car parking	Overshadowing	Option value
Local air quality	Isolation	Existence value
CO_2	Psychological distress	Amenity value
Noise	Site-specific	Indirect / altruistic value
Vibration	Tourism benefits	
Water quality	Urban regeneration	
Private resource cost savings	National strategic factors	
Users' economies of scale (Mohring effect)*		
Network effects		

* Note: where these benefits accrue to public transport users, they could also be labelled as 'mobility benefits'.

A1.3.2 Economic – Social (including Cross-sector) Benefits

Litman (1999) and Tyson (1991, 1999) provide a comprehensive description of the various economic benefits associated with access improvements resulting from the provision of public transport services. Lewis & Williams (1999) label most of these economic benefits as 'cross-sector' benefits (or, alternatively, as 'club' or 'spill over' benefits). They define them as 'economies achievable in another sector of the economy as a result of expenditure in the transport sector'. Fowkes et al. (1994, and quoted in CA-GD 1998) define these benefits with specific reference to passenger transport:

> *Cross-sector benefits represent efficiencies of resource use within and between sectors as a result of providing disabled and other people with accessible public transport.*

The provision of public transport services has been demonstrated to relieve the demand for and financial pressure on 'social safety net programmes' (Lewis & Williams 1999), in areas such as health, unemployment, nutrition and mental support services as well as provide the individual benefits arising from better access to employment and education opportunities. Tyson (1991) notes that some social problems (i.e. incomplete education, unemployment, social isolation, ill health)

created by lack of access are pre-empted. There is reduced pressure on institutional services, such as long-term hospital or elderly care, as people are able to remain in their homes and travel to the service.

The range of cross-sector or economic benefits includes:

- *More efficient public facilities* due to economies of agglomeration (or economies of scale): larger sites with more specialised services can be planned and executed because of better access.

- *Reduced expenditure on support services* such as health/hospital, unemployment, shopping, nutrition and mental health services, particularly services provided in the home and residential care (Symonds Travers Morgan 1995).

- *Increased productivity and employment* resulting in a more efficient economy as potential workers gain better access to employment opportunities creating the prospect of greater job satisfaction and productivity gains.

- *Producer benefits* when employers profit from the opportunity to get the best workers for their needs; retailers and service providers gain increased business and sales (WRC 2000).

- *More efficient city and regional centres* economically as access to shops and services can be concentrated in certain areas (and specialised support services developed).

- *Disadvantaged communities* are able to compete for economic development opportunities; all centres may experience an increase in international competitiveness.

- *Reduced dependency on imported goods* (vehicles and fuel), which provides macro-economic benefits to a country or region (Litman & Laube 1999).

Tyson (1991, 1999) also identifies a benefit from the release of land from roading or parking to be made available for other economic activities. The value of this land is already included in evaluations of public transport services and infrastructure using Transfund's (1997) *Evaluation Procedures for Alternatives to Roading.*

Including values for the benefits to city and regional centres of becoming more economically efficient, and perhaps more internationally competitive in an evaluation may result in the double counting of benefits because these benefits could be accounted for in valuing more efficient public facilities and producer-benefit efficiencies. This is an issue that will be clarified as part of the literature review.

Tyson (1991) acknowledges that valuing economic or cross-sector benefits is difficult, as the role of public transport is small but important.

A1.3.3 Economic – Personal Benefits

Depending on the characteristics of the service, personal economic benefits arise from increased employment, education, recreation and social opportunities (Litman 1999). Symonds Travers and Morgan (1995) call this 'social integration', wherein users gain greater independence and a better 'quality of life'. More recently, the term 'social exclusion' has been used to describe the various ways in which members of society can be excluded from normal activities and opportunities (such as for employment or education) because of some type of limitation. Seven categories of exclusion or limitation have been identified by Church (2000):

- physical exclusion of those who are physically or otherwise unable to access transport services;
- geographical exclusion or spatial isolation;
- exclusion from facilities, arising with the tendency of more centralised facilities such as supermarkets (as opposed to local shops), shopping centres and large area hospitals, and closure of smaller 'uneconomic' schools;
- economic exclusion based on income and transport network constraints;
- time-based exclusion where time constraints impact on mobility decisions;
- fear-based exclusion where fear for personal safety affects travel choices;
- space exclusion.

In some instances, providing public transport services may only generate a marginal impact on social exclusion as other factors may have a greater influence.

A1.3.4 Improved Physical Accessibility

The introduction of specific types of public transport services can improve the physical accessibility of some groups of people to transport by catering to their needs. For example, low floor or kneeling buses, or buses with chair lifts, can make it possible for the elderly or wheelchair-bound people to use public transport where they could not previously.

A1.3.5 Equity Value Benefits

Equity value benefits, to both users and society, are considered to result from improving access to services for people who are economically, socially or physically disadvantaged. Improving basic access overcomes inequity and restores competitive advantage for non-drivers who can now compete for jobs and education. Wellington Regional Council (2000) noted that the disadvantaged may include under 16-year olds, lower socio-economic groups, people unfit to drive for medical reasons, and the elderly. This definition of equity benefits overlaps some categories of social exclusion thought to be associated with personal economic benefits described above.

Currently (2002), the New Zealand Government provides some targeted funding for the transport disadvantaged through Transfund's budget for 'total mobility' (for those with physical or mental conditions) as well as concessionary fares (reduced fares for children and the elderly).

Worthwhile noting, however, is that certain groups within society do not fit the current New Zealand Government definitions of transport-disadvantaged, such as epileptics who cannot obtain a driver's licence, but can otherwise function normally in society, and those who cannot afford to purchase a car, or who may be temporarily without a driver's licence and are thus reliant on alternative modes of transport.

A1.3.6 Option Value Benefits

This is defined as the "'premium' the community may be prepared to pay to retain the option of using resources in the future" (WCS 1993). Option values reflect the uncertainty over future preferences or needs. The provision of a back-up transport service, in case of emergencies or changed conditions, is of value to the entire community, even to those who normally use cars (Litman 1999).

Booz Allen Hamilton (2001) posit that Option Value may be particularly significant in the case of passenger transport, relative to other services, due to the "importance of travel as a means of accessing facilities and the lack of other substitutes". This position is substantiated by a TCRP (1996) report, *Measuring and Valuing Transit Benefits and Disbenefits*, which discusses how events such as earthquakes, severe weather and climatic disasters, and the sudden absence of public transport caused by disruptions (i.e. labour strikes), demonstrate the importance of public transport as an option for those who, under other circumstances, may not be PT-dependent. Litman (1999) also notes its importance in "allowing the legal system to enforce traffic safety" by revoking the licences of dangerous or unsafe drivers. In cases where no other mobility option is available, such drivers may be allowed to keep their licences, sometimes with damaging outcomes.

Bristow et al. (1990) and Booz Allen (2001) note the need to distinguish between expected use benefits and additional 'option' value that an individual is willing-to-pay to secure the availability of a public transport service.

A1.3.7 Existence Value Benefits

The existence of a public transport network is considered to have a unifying impact on the areas served, thus contributing to integrating rather than isolating communities, and creating a sense of regional cohesion (Booz Allen 2001; Bristow et al. 1990; WRC 2000). Others have defined existence value as a variant of Option Value, wherein individuals are willing-to-pay for retaining resources irrespective of their expectations of future use.

A1.3.8 Amenity Value Benefits

Amenity Values are defined in the Resource Management Act 1991 (RMA, s2) as "those natural or physical qualities and characteristics of an area that contribute to people's appreciation of its pleasantness, aesthetic coherence, and cultural and recreational attributes". Increased traffic noise and congestion and reductions in safety are factors thought to impinge on urban amenity values (Office of PCfE 1997).

At the same time, certain types of public transport services, such as diesel buses (some of which emit particulates and are noisy) may have negative amenity value

impacts. Clearly, the positive and negative Amenity Values have to be taken into account in a full evaluation of the benefits of passenger transport.

Passenger transport may contribute to the Amenity Value of a residential area by improving the accessibility to services and shops within and beyond the area. Other Amenity Values, such as public view (visual impact) and open space protection, heritage and special character site protection, urban regeneration, and landscape values, are usually considered under the heading of 'intangible benefits' and, in New Zealand, have been incorporated into the current evaluation frameworks for alternatives to roading and patronage funding.

A1.3.9 Indirect or Altruistic Value Benefits

Bristow et al. (1990) and Booz Allen (2001) propose that a person may derive an Indirect Benefit from knowledge that others in the household (or friends or relatives) have access to and use passenger transport. The direct benefit to car drivers is that they do not have to give lifts to non-drivers.

In a broader sense, Bristow et al. (1990) define an Altruistic Benefit as that derived by all non-PT users in knowing that others in the community have access to passenger transport. It appears that Indirect Benefits may double-count Equity and Option Values. This is an issue that will need to be clarified in the literature review.

A1.4 Who Do Accessibility Benefits Apply to?

Do accessibility benefits apply to all members of the community or only to select public transport users? Should they be focused on particular trip types? Given that this research's focus is on mobility to achieve accessibility, the response will depend, in part, on the type of benefit under discussion. First of all, however, groups that have special needs with respect to accessibility are considered.

A1.4.1 People with Special Accessibility Requirements

Different groups in society may be recognised as having particular accessibility needs:

- People with disabilities, either physical or mental conditions, that affect their mobility so that they are unable to move around in society independently. Physical conditions may include age as a factor, so that children and the elderly are part of this group.
- The economically disadvantaged, i.e. those who cannot afford to purchase or hire a car or those who cannot afford to pay full cost for bus fares.
- Those who are temporarily unable to drive, i.e. those who have a suspended licence, whose car may be 'off the road' (for whatever reason), or those who have been drinking (particularly as this carries an element of reduced risk for the community).

People experiencing these types of difficulties concerning mobility or accessibility are often considered to be 'public transport dependent'.

Suen & Mitchell (2000) state that mobility limitations also include accompanying children or baggage, unfamiliarity with local area, and language barriers. These types of barriers do not necessarily create a public transport dependency; rather they may be factors that pre-empt the use of public transport.

A1.4.2 Impact of Improved Physical Accessibility on Public Transport Benefits

The extent of the benefits of public transport will depend, in part, on the type of public transport vehicle and infrastructure provided as the design may limit who gains physical access to the services. The introduction of specific types of public transport services can improve the physical accessibility for some groups of people to transport by catering to their needs. For example, low floor or kneeling buses, or buses with chair lifts, can make it possible for the elderly or wheelchair-bound people to use passenger transport where they could not previously. Similarly, the provision of ramps or lifts for a service which required users to climb steps to gain access to a platform will make the service more accessible to certain segments of the population.

A1.4.3 Trip Purpose

Lewis & Williams (1999) posit that the economic value people obtain from mobility is the value they derive from their journey purposes (e.g. work, shopping, education, health) minus the cost they pay. The value is not derived from the actual journeys themselves. They suggest that the value always exceeds the journey price because, if it did not, the trip would not be made. This implies that all trips made are of personal value to the public transport user, but raises the question as to whether they are of value to society and, consequently, should or should not be included in the evaluation framework. This issue will be further addressed in the literature review.

A1.4.4 Beneficiaries of Accessibility Benefits

Table A1.2 summarises the accessibility benefits for passenger transport described above and provides an indication of who is the recipient of the benefit.

The benefits of improved accessibility and increased employment and other activities are found to apply to all public transport users, whether or not they are public transport-dependent. This does not, however, imply that the community as a whole, through the Government, should provide (i.e. pay for) the benefit. Public transport users who have other mobility (transport) options available may not need the Government to increase them. It is perhaps helpful to think of such users as community members who have converted their option value to a user value.

Further consideration of who receives the benefits and whether or not they are quantified in the evaluation framework will be undertaken in the literature review.

Table A1.2 Beneficiaries of public transport accessibility benefits.

Type of Accessibility Benefit	Distribution of Benefits				Comments
	PT-Depend Users	Other PT Users	Non-users	Whole Community*	
Cross-Sector				√	
Improved accessibility to transportation (economic – personal benefit)	√	√?			Equity measure. Benefits to "other PT user" will depend on whether or not they have other mobility options available.
Increased employment & other activities (economic – personal benefit)	√	√?			Benefits to "other PT user" will depend on whether or not they have other mobility options available. Also, there is the question of what trip types should be included in such a benefit.
Equity value				√	
Option value			√		
Existence value			√		
Amenity value (other than those counted as intangibles)				√?	Benefit will possibly only apply to neighbourhood where passenger transport is provided.
Indirect/altruistic value				√	

* 'Whole Community' includes users and non-users of public transport.

A1.5 Some Comments on Measuring Accessibility Benefits

Various methods of estimating mobility and accessibility benefits have been suggested in the overseas literature (e.g. Lewis & Williams 1999; Litman 1999; Ross 2000; Tyson 1991, 1999). Some of these approaches are described below with a view to providing some direction for work on Stage 2 of the project, outlined in Chapter 4 of the main report.

A1.5.1 Cross-Sector Benefits

Symonds Travers Morgan (1995) and the Commonwealth of Australia Attorney-General's Department (AA-GD 1998) report on an exercise to value cross-sector benefits conducted by the Rowntree Foundation in the UK. The Rowntree Foundation looked at the potential financial savings in sectors other than transport, without accounting for the costs involved in providing or improving the transport system. Over one-half of the benefits arose in the area of "employment," being savings in welfare benefits plus income tax paid. Both reports were critical of the assumptions about job creation underlying this particular aspect of the valuation. The AA-GD reviewed the situation and demonstrated further approaches to calculation of the cross-sector employment benefits. This method of assessing cross-sector benefits will be more fully considered in later stages of this study reported here. A further potential concern is to ensure that the jobs created are new jobs and not merely a transfer of employment from one area to another as a result of new public transport services being provided (FTA 1993)

Lewis & Williams (1999) measure one aspect of cross-sector benefits relating to the reduced costs of providing support services by using a methodology to account for the delay of moves by the elderly or disabled from in-home services to institutional care, by the delay of moves by elderly or disabled from in-home services to institutional care, and through the substitution of improved mobility for in-home services. They note, however, that the decision to move from in-home to institutional care is complex, and may not be mobility-dependent.

Another approach by Lewis & Williams (1999) is to estimate the fiscal impacts of reducing public transport services on what they see as 'mobility sensitive' government programmes in the US, including Medicare, Food Stamps, Unemployment Insurance, and Medicaid. From this, they concluded that a $1 reduction in public transport/mobility programmes would lead to a net savings of $0.39 because of increased costs in mobility-sensitive programmes.

Ross (2000) discusses 'accessibility indicators' as means of quantifying the ease of travel, stating that it should show how low accessibility can be improved, and how accessibility is changing in a city over time. He discusses the use of 'gravity models' which describe the level of attraction of activities (such as jobs and residential areas) between locations. He develops a model using a formula based on mobility, which suggests that "the level of attraction declines with increasing distance" travelled. Not unsurprisingly, the model results indicate that the inner and core suburbs of cities are access-advantaged, while the outer and fringe suburbs were access-disadvantaged. At the same time, a comparison between cities found that Asian cities have the highest accessibility and US cities the lowest. While this finding may truly relate to 'ease of access' in Hong Kong, Singapore and Tokyo, the same may not be said of places such as Bangkok, Jakarta, Kuala Lumpur and Manila where the low per capita vehicle kilometres travelled does not mean that people have better access to the basic requirements for living. For such an analysis, it may be important to normalise for income.

Tyson (1999) summarises work estimating the impact of the Metrolink (London) on the local economy. He found that travel time savings resulting from the improvements impacted on businesses who gained access to a wider labour market and (potentially) reduced labour costs. He argued that the whole economy became more competitive and would lead to new businesses establishing in the area and contributing to the local economy.

Tyson (1991) restates that valuing economic or cross-sector benefits is difficult, as the role of passenger transport is small but important. He observes that there has been a lack of quantification of the benefits from passenger transport to the efficiency of public facilities.

More efficient public sector facilities

Tyson (1991) suggests that benefits from more efficient public facilities, i.e. scale economies, could be measured by comparing services of different sizes for cost of provision or by developing a 'production function' showing the inputs needed to produce a given level of output. He remarks that it is difficult to measure the

contribution of public transport service provision to these economies of scale, but suggests utilising the proportion of people using public transport services for access as a measure.

More efficient city and regional centres

If, as a result of further research, this benefit is determined to be a resource benefit, a means of measuring it may need to be derived. Care will be required to ensure that no double counting of benefits occurs. Tyson (1991) proposed that the relationships among turnover, rental values, etc., and the level and quality of public transport services could be compared. The contribution of passenger transport to linking areas could be assessed using time or time plus fare, and costs could be estimated and compared with frequency and expenditure per trip in the regional centre. While information is available which indicates the potential benefits of agglomeration or economies of scale, as well as the cost associated with urban sprawl (e.g. Litman 2000), the benefits that can be directly attributed to public transport are not clear. The literature appears to argue that urban densification policies lead to benefits for public transport, rather than that having a public transport network in place leads to urban densification.

A1.5.2 Personal Economic Benefits

To estimate the system-wide value of what they term 'low cost mobility', Lewis & Williams (1999) derive a consumer surplus curve based on the maximum amount that people are willing to pay for particular journey purposes, namely to work and for access to essential services. They take into account the role of taxis and other personal expenditure habits of households in their analysis. This methodology will be investigated further in Stage 2 of this study. Some issues to consider are its appropriateness for the New Zealand setting, what types of trips should be included, the suitability of using a consumer surplus curve, and so on.

A1.5.3 Equity and Option Values

Litman (1996) defines Equity and Option Values as externalities, with variable costs dependent on vehicle use. Booz Allen Hamilton (2001) suggest that the availability of taxis is expected to provide an upper limit on option value.

A1.5.4 Amenity Values

Lewis & Williams (1999) discuss at length the value of passenger transport to neighbourhoods or communities, beginning by assessing the historical importance of transport, particularly passenger transport, to the functioning of communities. They move on to describe various means of assessing the value of 'transit-oriented development attributes', including qualitative measures (focus groups and survey techniques), hedonic wage and price estimation, incorporating distances derived from Geographic Information Systems (GIS), and stated preference (SP) techniques. They conclude that the benefits of a PT-accessible neighbourhood can be measured by transportation cost savings and property value increases. Further work will be required to assess the viability of these options for use in the New Zealand context.

A1.6 Summary: Defining the Next Phase

A1.6.1 Accessibility Benefits & Current NZ Evaluation Framework

Based on all the information provided in the preceding sections, Table A1.3 summarises the accessibility benefits and indicates whether or not they are included in the current evaluation frameworks for passenger transport in New Zealand. In addition, the benefit is distinguished as a 'resource' or 'transfer' benefit and a brief comment is made as to how it may be measured, either in the current framework or as a result of this project.

Using the information contained in Table A1.3, the accessibility benefits that should be focused on can be determined in the subsequent stages of this project. Clearly those benefits that are already included in the other passenger transport evaluation frameworks can be excluded from further analysis. They are:

- Improved accessibility to transportation – not PT dependent;
- Increased opportunity for employment, education and other activities – not PT dependent.

In addition, some resource benefits exist that, on further examination, may result in measures that overlap those used for another benefit. This is known as 'double counting' of benefits. Such benefits and their measures can be excluded from further analysis. Several such benefits are identified in Table A1.3 including:

- Producer benefits;
- More efficient city and regional centres;
- Existence values.

Thus, the second phase of Stage 1 of the project (Literature Review) will focus on the following accessibility benefits:

- More efficient public facilities;
- Improved accessibility to transportation – PT dependent;
- Increased opportunity for employment, education and other activities – PT dependent;
- Producer benefits;
- More efficient city and regional centres;
- Equity value;
- Option value – non-users;
- Existence value;
- Amenity value;
- Indirect / altruistic value.

Table A1.3 Summary of accessibility benefits, their nature and inclusion in current evaluation frameworks.

Type of Benefit	Currently incl. in ATR & Patronage Funding	Resource or Transfer Benefit	Comments
More efficient public facilities (including economies of scale & reduced expenditure on services)	No	Resource	Financial & resource saving in public sector accruing to whole society. Potential measures include fiscal impact on support services if PT removed, or estimates of savings on in-home care.
Producer benefits – better choice of employees; greater retail and services sales	No	Resource	Employee may capture benefit through wages (assuming a competitive market); benefits of increased sales captured by retailers and service providers in profits.
More efficient city and regional centres (also called economies of agglomeration)	No	Resource	May be double counting benefits that are captured through measures for improved public facilities – producer benefits.
Improved accessibility to transportation (individual benefit) – not PT dependent	Yes	Resource	Measures used include travel time and VOC savings and valuations for service improvements.
Improved accessibility to transportation (individual benefit) – PT dependent	?	Resource	Current measures may be insufficient if mobility is provided where none existed before; measure based on consumer surplus curve may be appropriate.
Increased opportunity for employment, education & other activities (individual benefit) – not PT dependent	Yes	Resource	Incorporated in travel time and VOC savings and valuations for service improvements.
Increased opportunity for employment, education & other activities (individual benefit) – PT dependent	No	Resource	May be measured as part of the consumer surplus curve associated with PT.
Equity Value	No	Transfer	Currently NZ Govt funds Total Mobility for physically & mentally disabled; provides concessions for under 16s & elderly without assessment of benefit value. Measures for improved accessibility & increased employment, etc., may encapsulate any equity benefit.
Option value (non-users)	No	Resource	Must distinguish between expected use benefits & option value. May be a willingness-to-pay measure.
Existence value	No	Resource	May be double-counting amenity value.
Amenity value associated with presence of PT in a community	No	Resource	May be difficult to measure. Lewis & Williams (1999) suggest various methods of which hedonic pricing is recommended.
Indirect / altruistic value	No	Resource	May be measured as trips saved by individual drivers. Alternatively, could be a willingness-to-pay measure.

A1.6.2 Further Research Requirements

This Thinkpiece has raised a number of issues requiring further clarification and resolution in phase 2 (Literature Review) of Stage 1 of this research project wherein a full-scale literature review of material available in New Zealand and overseas was undertaken. In addition, consultation with other agencies and experts in the field was carried out. In the first instance, our definitions of the concepts of mobility and accessibility will be confirmed, and subsequently, our categorisation of mobility and accessibility benefits. We will also assess whether or not (1) who receives the benefit, and (2) the trip purpose, affect the inclusion of a benefit in the evaluation framework.

With specific regard to accessibility benefits, we will:

- Clarify their definitions;
- Confirm the nature of each benefit (i.e. transfer or resource benefit);
- Clarify who receives the benefit;
- Identify potential methods for measuring benefits and assess them for use in the New Zealand context;
- Comment on the values that have been derived elsewhere, particularly with reference to their use in the New Zealand setting.

In later stages of the project, we are committed to estimating both the total benefits of from existence of the public transport system, as well as the benefits of public funding (subsidy) of incremental changes to the system. Thus, assessment of appropriate methodologies will have to take into account both measurement needs.

A1.6.3 Approach to Literature Review

Databases

Keyword searches were undertaken on several major on-line databases, including, among others:

- TRIS (TRB)
- ATI (Australian Transport Index)
- ITRD
- TransportConnect
- Transportation Research Library (TRL)
- OECD / Cordis / COST
- UITP
- TCRP
- APTA

Proposed keywords include, but are not limited to, the following:

- accessib* + mobility
- accessib* + transit (accessib*+passenger or public AND transport)
- mobility + transit (mobility +passenger or public AND transport)
- option value
- existence value
- existence benefit*
- cross-sector benefit*

- public sector benefit*
- non-user benefit*
- altruistic value
- amenity value

Key sources

References in key papers were followed up, and the authors were contacted for further information about the references and other sources. In particular, we will follow up references and/or contact:

- Todd Litman (Canada),
- Lewis and Williams (US),
- William Ross (Australia),
- WJ Tyson (Europe).

Appendix 2 Literature Review Summary

Reduced Cost of Serving Population (A1)		
Category	**Article Summary**	**Article**
Benefit Description	- Medical benefits – result primarily from the avoided costs of more intensive care, as by continuing to see one's own doctor, but also from being able to stay mobile and thereby care for oneself at home, from getting bussed to nutrition programs, and from getting meals delivered at home. - Shopping and other benefits – assigned an estimated value for a round-trip shopping journey, recreational and 'other' trip. Cross-sector benefits are the wider socio-economic effects that result from giving people the opportunity and choice to travel through the provision of accessible public transport.	TCRP Rep 49 Fowkes 1994
Recipient Type	• Focus in all 'cross-sector' studies is the transport disadvantaged, particularly people with disabilities.	
Trip Purpose	• Focus generally on medical trips; but other trip purposes also covered.	
Subsidy v Service	• Studies generally assessed value of service; but one study also examined benefit of change in level of service.	
Methodology and Values	• Improved public facilities – in principle possible to measure increased efficiency of larger schools etc. by comparing schools of different sizes or by developing a production function showing the inputs needed to produce a given level of output. However, determining the PT contribution to achieving these benefits is more difficult. A crude measure could be based on proportions of people using public transport for access. • Cross-Sector fiscal impacts – estimated increases in health/social welfare program costs of $396M associated with a 10% ($650M) reduction in funding for low cost mobility programs. - Theoretically based upon UK MVA & CCLT studies - Developed model which estimates the fiscal impact on different health services of reducing PT funding. The model uses elasticities (wrt to funding and service) and assumptions about proportion of trips that go to welfare programs. • *Cross-Sector benefits* Reports on two studies: MVA study & Cranfield Centre for Logistics and Transportation (CCLT) study. Main Findings: *Residential Care* -MVA little evidence that Accessible PT (APT) has substantial role in delaying transition from domiciliary care to residential care (based on interviews with people living in sheltered & residential accommodation and with wardens/managers of establishments). - CCLT found that suitable transport can delay time at which transition occurs. Although apparently in conflict, these studies show complexity of transition process, and difference innovative transport can make. *Domiciliary Services* - both studies found strong relationship between ability to use PT and provision of domiciliary services, implying provision of APT services and greater mobility leads to cross-sector benefits for domiciliary services. *Cross-Sector Benefits* Size of cross-sector benefits depend on respective costs of transport and domiciliary services, and the number of home visits replaced. Trip replacement rates for different types of domiciliary visit were estimated. Applying these to estimated visit durations and hourly costs, a net-saving of £30,000 – 40,000 pa per 1,000 people was estimated.	Tyson 1991 Lewis & Williams 1999 Carr & Lund 1994

	- Medical program benefit: 27.2% of respondents indicated that they "can stay in my home instead of going to a nursing home or hospital" because of the program (transport assistance to medical care). To quantify this benefit a conservative assumption was made that only 2% of those responding actually avoid going to a hospital because of the program, and only 10% avoid going into a nursing home. An additional assumption was made that 10% of respondents avoid using the ambulance service. National average cost data from the Health Care Financing Administration was used to calculate the avoided medical costs. - In addition, it was assumed that 100% of those answering the questions related to transport assistance to medical care received some benefit ie to cover such responses as "I can get care before I get much sicker". The 22% o respondents who received benefits by avoiding more intensive care were deducted, so that 78% of this group included in benefit estimation. A cost saving of $60 to the patient or the doctor was assigned (patient saves if he can avoid multiple visits, and doctor saves by avoiding missed appointments because of lack of transport.	TCRP Rep 49 – MTA) Immediate Needs Transport-ation Program
	• The Easibus survey results showed that similar proportions of Easibus and non-Easibus users receive domiciliary visits from doctors and nurses. However, the after-survey findings implied an average of 0.5 annual visits for Easibus users against 2 annual visits for non-users. Aggregated against Eastbus travellers this equates to approximately 10,000 fewer annual visits for Easibus users compared to a similar number of non-users for the target groups. At estimated costs of domiciliary visits by doctors this is equivalent to additional costs of €600,000 - €750,000 annually. It is not clear, however, whether Easibus produced this effect or whether this difference simply reflects levels of mobility and better health among those who are capable of using Easibus.	Evans & Smyth 1997
	• Identified that significant resource savings might be made in following areas if public transport services made more accessible: domiciliary care, shopping and home care services, meals in home, day care centres, residential care, informal care, hospital out-patients, employment, social integration. • Made preliminary estimates of cross-sector benefits that could arise in UK context if access to public transport could be improved. Total benefits (for all areas above) estimated to range from €256M to €1,161M, with employment benefits making up half of the estimated benefit. • These estimates assumed that people with disabilities are provided with a level of mobility comparable to that of able-bodied people; and, take no account of costs involved in improving the transport system. The estimates were based on preliminary research in this area and thorough informal discussions with health professionals. • Employment benefit estimate methodology: 15% of adults with disabilities looking for work, 39% of these noted that the journey to work was a problem 'because of their disability' – this proportion taken as potential target population, 10% - 50% (25% medium estimate) of target population assumed to gain employment as result of improved transport system accessibility, those gaining employment assumed to earn average full-time wage, as compared with being dependent on state benefits at present, the people gaining employment would fill newly-created positions rather than displace others from jobs. Public cost savings equals savings in welfare benefits plus the income tax paid.	Fowkes 1994
	• Adjusted Fowkes cross-sector benefit estimate for Australia, adjusting for relative populations and exchange rate, to give benefits of around A$200M – A$900M pa.	STM 1995

	Reviewed Fowkes' study for Australian conditions. • Concluded that Fowkes view that employment taken up by people with disabilities would represent new rather than displaced jobs was correct. • Adopted Fowkes' approach re employment benefits: in 1993 3,000 – 15,000 unemployed people with a disability would be enabled to secure employment. • Developed alternative approach (B): identified 'excess' unemployment rate of people with disabilities (disability unemployment rate less general population unemployment rate), which in this case was 6.5%. Applied this rate to total number of people with a mobility handicap in the workforce, giving 25,000 people. 39% of these have transport as a problem (according to Fowkes), which equates to around 10,000 people. Using Fowkes range (10-50%) gave 1,000 – 5,000 people able to secure employment through improved public transport accessibility. • Booz Allen considered that approach B was the more credible. Potential cross-sector benefits were then calculated in terms of savings in benefits paid to people with a disability and income tax contributions paid by these newly employed people (as per Fowkes). This gave estimated total benefits per annum of $15M - $76M. • Did not review Fowkes Other Benefits (which would be a major study in itself), but noted that, adjusting for relative populations and exchange rates, these benefits would range from A$80M - $323M per annum. • Produced estimates of future annual cross-sector benefits with the following adjustments: employment benefits scaled up in accordance with projected population growth, 'other' benefits scaled up in accordance with projected growth in number of people with mobility handicaps, and, both sets of estimates rescaled in accordance with level of public transport accessibility consistent with the compliance schedule provided in the 'draft standards'.	Booz Allen Hamilton 1998

More Efficient Location/Design of Public Facilities (A2)

Category	Article Summary	Article
Benefit Description	• More Efficient Public Facilities – many community facilities (eg hospitals, schools, universities) are making increasing use of larger facilities because: using more complex and technical equipment and skills; can provide wider range of courses etc on larger sites; and, scale economies. These larger facilities mean there will be less for a given population and access becomes more difficult. PT provides access which is available for all.	Tyson 1991
Recipient Type	• None specified	
Trip Purpose	• None specified	
Subsidy v Service	• None specified	
Methodology and Values	• Improved public facilities – in principle possible to measure increased efficiency of larger schools etc by comparing schools of different sizes or by developing a production function showing the inputs needed to produce a given level of output. However, determining the PT contribution to achieving these benefits is more difficult. A crude measure could be based on proportions of people using public transport for access.	Tyson 1991

Producer benefits – better choice of employees; greater retail and services sales (B)		
Category	**Article Summary**	**Article**
Benefit Description	- Improves efficiency of labour markets by giving all potential workers access to employment opportunities. If there were less public transport only workers with cars would have access to jobs beyond walking distance from home. Only by drawing on a wide range of skills can many modern industrial and commercial enterprises prosper. Also, job satisfaction is increased with further consequential gains in productivity.	Tyson 1991
	• *Commercial Property Benefits of Transit*: urban economics literature has early on established that access to transit, as a positive amenity, will be 'capitalised' in the value of land and residential or commercial property. The nature of benefits for commercial property is dual: the proximity of transit may not only facilitate the access to customers but also the access of the work force.	FTA 2000
Recipient Type	• None specified	
Trip Purpose	• Work and retail	
Subsidy v Service	• Services	
Methodology and Values	• Improved labour market efficiency can be seen from lower wage and salary costs: Professor N Lichfield in 1980s for Greater Manchester PTE examined impact of withdrawing bus services from a large industrial estate and concluded that it would have some impact on wage and salary costs.	Tyson 1991
	• Pee Dee Regional Transportation Authority's (PDRTA) 24 Hour Rural Commute Service (Marion County, South Carolina) – these are 'welfare to work' services whereby unemployed are bused to Myrtle Beach. The service is funded by PDRTA; but 3 Myrtle Beach employers also provide funding to ensure the buses meet their schedules and will not be cancelled if ridership lags. - Subsidy amount from employers, representing the value of the service to them.	TCRP Rep 49
	Commercial Property Benefits of Transit • Two approaches have been used in the literature to address similar issues: - regional scale analyses, which focus on the changes in commercial property values brought about by a change in the transit system (e.g. opening of a new bus line); and, property level analyses which concentrate on the differential impact that public transit has on surrounding properties.	FTA 2000
	• A property level analysis was undertaken. The best technique to evaluate this impact consists of estimating a hedonic price model, where the value of selected commercial properties are regressed on a set of property characteristics. FTA did this, with the estimated coefficients of the hedonic price equation then used to evaluate the impact of transit on commercial property within the area of study. The impact was then expressed as a dollar increment on property value per foot of proximity to transit. It was then a straightforward task to evaluate the average and total impact of transit within the area of study.	
	• Results (based on analysis of data on 2,800 commercial properties in Washington DC randomly selected): 1 metre decrease in distance from transit resulted in a $0.008 property value increase per square foot. Note: this value from semi-log model specification; benefit value is quite sensitive to the choice of functional form of regression model eg range of values from 3 models was $0.37 - $2.29 value increase per square foot for a 1000 feet distance from transit decrease, with $2.30 being semi-log model, which is	

	considered to be the best functional form that reflect underlying market dynamics. • Findings consistent with other similar studies, e.g. TCRP 1998 found that in Washington DC, commercial properties within 1000 feet of a transit station enjoyed premium values of $2.00 to $4.00 per square foot. Estimate of $2.29 falls within this range. Because properties chosen randomly the results are representative of the population of commercial properties located in Washington DC. • Note: an alternative to the hedonic methodology is stated preference survey methods ie asking households or individuals to state their willingness to pay for public goods. There is a need for an alternative approach as the hedonic approach cannot always be applied.	

More efficient city and regional centres (C)		
Category	**Article Summary**	**Article**
Benefit Description	• Agglomeration Benefits – the higher productivity, creativity, and synergy associated with increased face-to-face contact, access to specialised labour, and external transactions made possible by more compact, transit served development (Note – tends to focus on clustering around rail transit stops). • Urbanisation Benefits: the reduced outlay for urban infrastructure, such as streets, water lines, and sanitation facilities, that result from the more compact patterns of development that transit service makes possible. • Both agglomeration & urbanisation benefits accrue from transit-induced compact development, and are therefore strongly associated with high levels of accessibility. • Notes that accessibility benefits, and thus, indirectly agglomeration & urbanisation benefits, are normally capitalised into land values and rents. Parcels enjoying these benefits are in more demand, and consequently rents are bid up for these choice locations. • *Agglomeration economies*: decline in production costs due to the concentration of economic activity in a specified geographic area. In this context, the presence of a well-functioning transit system is thought to strengthen the impact of agglomeration economies (particularly in congested conditions), and thereby to help cities function even better ie urban efficiency. This includes facilitation of transfer of workers across firms and industries and promoting the efficiency of urban labour markets. Other things being equal, transit enables a higher degree of agglomeration which in turn results in higher productivity and stimulates economic growth.	TCRP Rep 35 FTA 2000
Recipient Type	• None specified	
Trip Purpose	• None specified	
Subsidy v Service	• Value of services	
Methodology and Values	• More efficient city and regional centres – it may be possible to estimate benefits by looking for relationships amongst turnover, rental values, etc and the level and quality of public transport (this could be done against measures of PT accessibility using time or time plus fare cost and compared with frequency of trips and expenditure per trip in the regional centre. • Tested the hypothesis that the presence of an extended and well-functioning mass transit system promotes the realisation of agglomeration economies and thereby stimulates economic efficiency (measured by labour	Tyson 1991 FTA 2000

	productivity) in large urban areas. Methodology used was a multi-regression analysis with productivity (value added/employment) as the dependent variable and a number of variables including presence of transit (number of vehicles directly operated in maximum service). The data set covered the 100 densest Metropolitan Statistical Areas. The analysis found that the total agglomeration effect in MSA with high transit presence is stronger (0.108066) than in MSA with low transit presence (0.067583). Hypothesis therefore validated. • Tested hypothesis that there exists a positive relationship between transit presence and economic growth ie independently from its effect on productivity. Value added growth, as a measure of economic growth, was the dependent variable (productivity became one of the explanatory variables). The multi-regression analysis found that transit presence was significant at the 5% level, and therefore that presence of transit does contribute to economic growth. • The coefficient estimates from the regression analysis were used to estimate the average impacts of the presence of transit on productivity and economic growth. This found that: - a +1% change in transit presence results in a +0.04% change in productivity, with average productivity gain per employee of $19. - a +1% change in transit presence results in added economic growth (5 year) of +0.10% (additional to impact on productivity). • The aggregate impact of transit in the USA for a +1% change in transit presence was estimated to be $2.4 billion annual value created due to productivity gains and $0.5 billion annual value created due to economic growth.	

Increased opportunity for employment, education & other activities (individual benefit) – not PT dependent (D1)		
Category	**Article Summary**	**Article**
Benefit Description	- Access for customers to shops and services which can be concentrated in particular areas, which is important for economic prosperity.	Tyson 1991
Recipient Type	Priorities for services: workplaces were ranked highest, followed (in order) by shops, schools, and medical facilities. - weekday peak services were thus ranked as most important, followed by weekday daytime services, Saturdays, evenings and Sundays. - priority for support: pensioners were ranked first, followed in Rainow (Cheshire) by the unemployed and then children; in Hawksworth (Leeds) the unemployed were ranked last.	Bristow et al. 1991
Trip Purpose	• Work trips ranked first in one study	
Subsidy v Service	• Service	
Methodology and Values	• Used a personal interview survey approach to attempt to value use and non-use benefits of a PT service. Two WTP surveys carried out: in an urban area (Hawksworth, Leeds) and a rural area (Rainow, Cheshire). Valuations obtained for use and non-use benefits for route and network. • Found that: - users typically obtain a consumer surplus in the order of 100% of the fare they pay.	Bristow et al. 1991
	• Transit Value to Neighbourhoods - focuses on benefit gained from close proximity to rail transit stations - uses Hedonic Pricing: attempt to estimate a price for a public good by looking for a surrogate market (functioning market for goods and services where specific attributes (public goods) will be capitalised into the value of the observed goods and services). The surrogate market is observed where the attributes are deemed to be present and where they are deemed to be absent. Assuming perfectly functioning markets and market clearing prices, the value of attributes will equal the difference between the observed prices in the two markets. The property market is often used as the surrogate market. Hedonic price estimation is done using multiple regression where the change in property values are a function of community amenities and other social and economic variables. The regression coefficients are then used to calculate the implicit marginal prices of the amenities. Previous Hedonic Pricing studies: Washington Metrorail - ave price for a townhouse within 1000 feet of the rail station $12,300 higher than comparable units further away (Gatzlaff & Smith 1993) - Lerman et al. 1978 – for a single family home a 10% change in distance results in a 1.2% change in property value; 10% change in distance from station resulted in 6.8% change in retail property values. Lindenwold, Philadelphia - Rice Centre study found station location resulted in a 7% premium on property value. - Voith 1993 found that areas with commuter rail service had house price premiums of 6.4%. Fichburg per Gardner line, Boston - RJ Armstrong: 6.7% property value premium for areas in proximity of existing rail stations compared to areas without rail access. Los Angeles Metro Rail: Fejarang examined 152 commercial properties; properties near rail had a mean sale price per sq foot 30% higher than properties away from rail.	Lewis & Williams 1999

	New Research Hickling Lewis undertook new hedonic pricing research using GIS to measure as accurately as possible the walking distance to transit, the key variable in hedonic models of transit-oriented neighbourhoods. San Francisco BART: mostly single family home area with middle-high income residents; area of transit impact assumed to be 1 mile from Pleasant Hill station. Results: homeowners willing to pay, on average, nearly $16 in home price for each foot closer to BART within the study area. The value of average single family home in station area is $22,767 greater due to its proximity to BART. Note that these property value impacts reflect an array of benefits from transit access, with some of the premium paid for proximity to transit compensating for reduced travel costs (measured by trips actually taken). But, also non-use benefit, i.e. may people living in area pay premium but do not use transit; and, the amount of observed property premium too large to be explained by user benefits. New York City Queens Study area Value of average home within subway station area is about $37,000 greater than a home outside the station areas. On average home prices decline about $23 for every foot further from the subway stations. Portland East End – property values increase by $0.76 for every foot closer to light rail within the 2500 feet to 5280 feet distance to transit range in sample. This is much less than for San Francisco and BART. Suggested that the difference is that Portland is Light Rail on road rather than separate track rail. *Transit-Induced Accessibility and Agglomeration Benefits* Since clustered development increases both ease and convenience of access and agglomeration-related economic productivity, no attempt is made to separate one from the other. Rather, they are treated jointly as "accessibility/ agglomeration" benefits by the techniques presented. • Focus on applying empirical evidence on how transit investments increase property values. • Methods and applications are limited to rail transit systems since only these investments have been shown in the past to materially increase land values. • Methods for measuring land value premiums: - Hedonic Price Models : regression analysis. - Matched-pair comparisons : rely on finding comparable properties that are in very way similar except one is close to rail transit and the other is not. - Repeat sales ratios: changes in prices & rents between two or more sales transactions for the same transit-served property are compared to price changes for repeat sales of properties unserved by transit to produce a ratio. The differential can be attributed to transit proximity controlling for other factors. • Method for measuring accessibility and agglomeration benefits based on two inputs: 1. amount of development occurring in station areas before and after the opening of a rail system; and, 2. value premiums associated with specific land uses and defined over distance intervals. • Summary of Transit Capitalisation studies provided: results differentiated by rail type (rapid rail/commuter rail/advanced light rail, light rail) and by land use type (single family/low density residential, multi-family/medium density residential, office, commercial-retail, other land uses).	TCRP Rep 35

	• Estimated that the accessibility and agglomeration benefits associated with BART's station area development (for 25 of 36 stations) over the first 20 years of service amounted to $224 million.	
	• Hedonic price estimation – mentions studies on property values which consider benefits and costs of increased land access from the development of transit: - Gatzlaff & Smith 1993 studied impact of Miami Metrorail system on residential property values near rail stations – concluded no major effect on residential property values, effects that did occur varied significantly by distance to station, and some variation in neighbourhood types as well. - Lewis-Workman & Brod 1997: 3 areas studied: BART-Pleasant Hill (San Francisco), Queens MTA (New York City), MAX (Portland East End). BART & MTA studies found strong property value benefits from proximity to transit stations, along with non-user benefits as evidenced by observed willingness to pay to live closer to station and by comparing observed time saving. MAX study found no benefits from proximity to transit stations. - Cervero 1994; 5 station areas in metropolitan Washington DC, and Atlanta where significant commercial development occurred from 1978-1989. Found 'average office rent' to be closely correlated with most transit factors. Office rents more strongly influenced by transit ridership than by traffic volumes on a nearby freeway.	Forken-brock et al. 2001
	• AC Transit (Oakland, California) service cuts – data from survey of people at public hearings and on-board user survey used to estimate economic costs of service reductions: - Added travel expenses. 43% of respondents reported added costs for present mode of travel in pace of former AC Transit trip (mostly taxi expenses). - Past income losses. Average of $324 per month in lost income experienced by 7.4% of respondents for an average of 4.35 months. - Continuing income losses. These losses continuing at average of $393/month for 4.2% of respondents. - Added travel time. 43% of respondents reported increases in travel time over their previous bus trip. - Total annual costs of $48M estimated against a saving of $4.8M in operating costs.	TCRP Rep 49
	Impact of Light Rail on Single-Family Home Values • Hedonic analysis (using GIS to create spatial-related variables) of impact of Light Rail system (MAX) in Portland on single-family home values using distance to rail stations as a proxy for accessibility and distance to the line itself as a proxy for nuisance effects. • Results: distance to LRT station (and its square term) are significant close to the 0.01 level. At 100m away from stations each additional metre further away will result in a $32.20 decrease in price for an average price house at $85,724. Distance to rail line (proxy for nuisance effect) had the right sign but was not statistically significant. Nevertheless, failure to include the variable results in distortions for the distance to station variable. Thus, this implies that there are combined effects and previous studies may have found inconsistent results or underestimated the value of access by not separately accounting for the nuisance and accessibility impacts of rail lines and stations.	Chen et al. 1998

Increased opportunity for employment, education & other activities (individual benefit) – PT dependent (D2)		
Category	**Article Summary**	**Article**
Benefit Description	• Three types of mobility benefits identified: - Job benefits – result from enabling formerly unemployed or underemployed passengers to reach their job sites. Can include the value of missing employment, business and education trips. Known costs of job training deducted. - Shopping and other benefits – assigned an estimated value for a round-trip shopping journey, recreational and 'other' trip.	TCRP Rep 49
Recipient Type	• Transport disadvantaged, particularly the unemployed and people without cars	
Trip Purpose	• Benefit values differentiated by trip purpose: work, medical, shopping, etc.	
Subsidy v Service	• Benefits of service	
Methodology and Values	Low Cost Mobility Benefits of Transit: • Consumer surplus – the economic value people obtain from low cost mobility is the value they derive from their journey purposes (work, shopping, going to school etc) minus the fares they pay. 1993 US national values calculated: $33.7 billion value for individuals from trips, $16.24 billion in expenditures, resulting in $17.5 billion net economic return. - the PT demand curve against fare level was estimated using knowledge of: total PT trips and average fare, average fare elasticity, and assuming higher fare elasticities at higher fares (based on high income elasticities of low income groups wrt taxi usage). - the area below the demand curve and above the total PT trip/average fare line taken as consumer surplus (demand curve modified to take out very high fare levels by simple linear interpretation). • Included in Hedonic Pricing studies of transit Value to Neighbourhood. • OATS, Inc (a door-to-door rural transportation service in Missouri) - To estimate economic benefits of OATS asked the question 'What costs would be incurred by OATS users in the absence of the OATS system?' It was determined that users would either: not make a desired trip at all because a transportation alternative is not available or affordable to the user; substitute an auto trip for the OATS trip, most of which would be provided by family members of friends (most users cannot drive or do not have access to a car); or, utilise another transport provider to make the desired trip. - The first step was to estimate how many of the existing OATS trips would fall into each of the above categories. In the absence of empirical data, estimates were made by trip purpose (shopping, employment, medical etc.), e.g. for discretionary trips such as recreation and business trips it was assumed that 50% of trips would not be made, whereas only 20% of education trips would be missed. - A value was then assigned to missing trips, auto substitute trips, and substitute paratransit trips by trip purpose. For example, for missing medical trips an estimate of $84 per round trip was made based on an analysis of Medicare claims and payments, while missing employment trips were assigned a value of $48 per round trip (8 hour working day at low average wage rate of $6/hour). Substitute auto trips were valued at $9.20 per one way trip which accounted for vehicle operating costs, driver's time, and wait time. Substitute paratransit costs were estimated based on costs of alternative modes and likely usage rates. - The number of trips in each category/trip purpose was then multiplied by the appropriate category percentage rate and value to determine the annual benefit in each of these categories.	Lewis & Williams 1999 Various TCRP Rep 49

	- The estimated annual benefits were $5.3M for missing trips, $2.5M for auto substitute trips, and, $5.6M for substitute paratransit trips. - In addition, the value of lost volunteer worker services was estimated at $0.5M per annum. • Pee Dee Regional Transportation Authority's (PDRTA) 24 Hour Rural Commute Service (Marion County, South Carolina) – these are 'welfare to work' services whereby unemployed are bused to Myrtle Beach. The service is funded by PDRTA; but 3 Myrtle Beach employers also provide funding to ensure the buses meet their schedules and will not be cancelled if ridership lags. - On-board survey undertaken: 71% indicated they could not keep their job if there was no PDRTA bus, the major reason being they had no car. The economic benefits of the service were calculated by multiplying the 380 people riding the buses by 71%, and then by the personal earnings reported (total earnings for those previously unemployed, and additional earnings for those who now had a higher paying job). Added to this was the subsidy amount from employers, representing the value of the service to them. The fares paid were deducted form this amount, for a net annual benefit of $2.1M. - The savings in unemployment and welfare payments were not included in benefits because they are offset by losses of those same funds to PDRTA riders, creating a 'wash' in benefits. • Southeastern Pennsylvania Transportation Authority (SEPTA) Horsham Breeze Service – a 11 mile loop shuttle service between Willow Grove Park Mall and suburban employment centres in Horsham Township. - User survey undertaken to facilitate estimation of benefits. Similar benefit estimation approach to PDRTA: - Income benefits for formerly unemployed for % who could not keep job if bus not provided. - Income gains for previously employed. - Travel cost benefits. - In addition, parking cost savings were estimated. - Purchases by bus users shopping at the Mall were not included as these are transfer payments. The value of travel time was also not included, as sufficient data was not collected to enable identification of users who utilise their commute time productively, e.g. reading on bus. • Los Angeles County Metropolitan Transportation Authority's (MTA) Immediate Needs Transportation Program – A $5M program funding both taxi vouchers and bus tokens, with the focus on providing trips to essential services. - A sample of the 600 social service agencies involved in the scheme surveyed (2 job assistance agencies and 3 medical assistance agencies). - Job program benefit: program provides transport to job training and to job interviews. Value of these trips calculated as average wage for jobs obtained as a result of training and interviews, less cost of training.	

Equity value (E)		
Category	**Article Summary**	**Article**
Benefit Description	• None	
Recipient Type	• None	
Trip Purpose	• None	
Subsidy v Service	• None	
Methodology and Values	• None	

Option value (non-users) (F) *Existence value (G)* *Amenity value associated with presence of PT in a community (H)* *Indirect / altruistic value (I)*		
Category	**Article Summary**	**Article**
Benefit Description	• None	
Recipient Type	• None	
Trip Purpose	• None	
Subsidy v Service	• Service	
Methodology and Values	• Used a personal interview survey approach to attempt to value use and non-use benefits of a PT service. - non-use values are significant with residents willing, on average, to pay around 60p per week to preserve the route as a whole (compares to average fare of 34p-45p). - non-users reported higher non-use wtp values than users. It is surmised that this may be due to: users being financially constrained as they had already expressed their willingness to pay in terms of their own fare; and, non-users tending to have higher incomes than users and thus a greater ability to pay. • Included in Hedonic Pricing studies of transit Value to Neighbourhood.	Bristow et al. 1991 Various

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