Pricing strategies for public transport
Part 1
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Neil Douglas
Douglas Economics

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NZ Transport Agency
Private Bag 6995, Wellington 6141, New Zealand
Telephone 64 4 894 5400; facsimile 64 4 894 6100
research@nzta.govt.nz
www.nzta.govt.nz

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Part 2: Literature review: 103pp
Part 3: Appendices: 85pp

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An important note for the reader

Erratum

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Table 6.25 page 165 and table 6.26 page 175 corrected.

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Abbreviations and acronyms

ADL	Alexander Dennis Ltd (buses)
ASC	alternative specific constant
AT	Auckland Transport
ATC	Australian Transport Council
AUC	Auckland
CHC	Christchurch
ECAN	Environment Canterbury
EEM	*Economic evaluation manual* (NZ Transport Agency)
EEMV2	*Economic evaluation manual volume 2*
GWRC	Greater Wellington Regional Council
h	hour
IVT	in-vehicle time
PCIE	Pacific Consulting (now Douglas Economics)
PE	priority evaluator
RP	revealed preference
RTI	real-time information
SDG	Steer Davies Gleave
SP	stated preference
SQI	service quality index
TfL	Transport for London
TP	transfer price
Transport Agency	New Zealand Transport Agency
UD	universal design
WEL or WTN	Wellington (WEL denoting Wellington rail station and WTN the city)

Contents

Executive summary

The study assessed the trade-off between price and quality for bus and train users in Auckland, Christchurch and Wellington. A survey of 12,557 bus and rail passengers was carried out between November 2012 and May 2013 on 1,082 different bus and train services.

The survey used a rating questionnaire and a stated preference (SP) questionnaire. The rating questionnaire asked passengers to rate their bus stop or train station and the buses or trains they were using on a quality scale between very poor and very good. The SP questionnaire presented pair-wise journey choices in which the in-vehicle time, frequency, fare, vehicle quality and stop quality varied.

The study estimated an average value of in-vehicle time of $9.09/hour. The value of time was found to increase with income from $5/hour at 'zero' income to $18.50/hour at $135,000 per year.

Service interval, which measured the number of minutes between departures, was valued less than in-vehicle time with a minute of service interval equal to 0.7 minutes of in-vehicle time on average. The valuation was not constant, however, being equal to in-vehicle time at high frequencies only around 0.2 at hourly services.

The rating of vehicle quality ranged from 65% to around 85% across the 43 bus and train corridors in Auckland, Christchurch and Wellington. The willingness to pay for the 20% rating difference was estimated to be worth around 32 cents or 8% per trip of the $4 average fare.

Data on vehicle age, type, air conditioning etc provided by the regional authorities was used to explain the variation in the passenger ratings of the vehicles surveyed. As bus and trains aged, their passenger rating and service valuation declined. Compared with an eight-year-old standard bus, passengers were willing to pay a 5.9% higher fare for a new train, a 4.7% higher fare for a new 'premium' bus, 2.5% for a new trolley bus and 1.6% for a new standard bus.

The profile of passengers was found to influence the vehicle ratings. Females tended to rate their bus or train higher than males by around 1.6%, retired passengers rated 5.5% higher but young respondents (<18 years old) 3.5% lower.

As well as providing an overall rating, passengers were asked to rate a set of vehicle attributes. Ride quality, staff and outside appearance were found to be the three most important attributes in terms of their ability to explain the overall vehicle rating. Attribute importance varied by the passenger characteristics however. Females for example, placed more importance on the inside cleanliness of the vehicle and less on environmental impact when compared with men. Retired passengers attached more importance to seat availability and comfort and less on the environment than other respondents.

In terms of bus stops and train stations, the bus stop ratings ranged from 60% to 81% across 35 bus routes whereas the range in rail stations varied by only 61% to 71% over eight rail routes. The range in rating widened when assessed by bus stop and train station.

For bus stops, the overall rating was found to range from a low of 46% when no facilities were provided as assessed from a passenger perspective to 75% at bus stops where shelter, seating, real-time information (RTI) and a timetable was provided. When valued, the willingness to pay from providing a shelter was worth 9% of fare, seating 3%, RTI 3% and a timetable 2%.

In terms of importance, a shelter was found to explain 51% of the overall bus stop rating, RTI 20%, seating 17% and a timetable 12%.

The ratings of bus stops varied according to the profile of the passenger, weather, location and wait time. Retired passengers tended to rate their bus stop higher (5.5%) than non-retired respondents. Bus stop ratings also reduced by 3.4% when it was raining. City centre bus stops rated 4.7% lower than bus stations and suburban bus stops 7.6% lower. The rating also decreased as waiting time increased although the decrease was very gradual at 0.3% per minute.

A second strand of analysis assessed the relative importance of individual bus stop attributes in explaining the overall rating. Cleanliness and graffiti, weather protection and seating were found to be the three most important attributes with each attribute explaining a quarter of the overall bus stop rating. Information explained 18% and lighting was the least important explaining 10%.

Retired passengers attached greater importance to weather protection whereas young passengers were more concerned about information at their bus stop. Respondents who waited longer than 10 minutes placed a greater importance on information and less importance on seating and weather protection.

As regards rail stations, the highest-rated train station across the Auckland and Wellington networks was Newmarket which had largely been rebuilt in 2010 and scored 79%. The lowest-rated station was Ava in Wellington, a station plagued by graffiti attacks and which only managed a rating of 25%. The difference in rating for Newmarket over Ava station was worth 30% of the average fare.

Analysis found that stations that had been upgraded within the previous 10 years rated 7.1% higher than stations that had not been upgraded and stations that had been upgraded within the previous five years rated 10.4% higher. The analysis valued a station upgrade to be worth 6% of the average fare within the first five years and 4% in the second five years.

Passengers travelling in the off-peak rated their station 2.5% higher than peak travellers. Likewise retired passengers rated 5.5% higher and house persons 5.3% higher than students and employed passengers. Passengers making entertainment/holiday trips rated 4.2% higher whereas passengers accessing by car rated 2.7% lower than passengers who walked or used bus.

For Wellington, a ‘before and after’ upgrade analysis of station ratings was undertaken by comparing the 2012/13 data with a similar rating survey undertaken a decade previously in 2002/04. The analysis related the change in rating by stations enabling those stations where upgrades had been undertaken to those where no upgrade had been made.

At stations where upgrades had occurred, the overall rating was found to have increased by 22.5%. The rating uplift then gradually decreased by 2% a year so that after 10 years the rating effect was fully eroded. By using the SP results, the value of the upgrade was estimated to be worth 11% of the average fare for the first year and 2% for the tenth year after the upgrade.

The earlier 2002/04 rating survey data was also pooled with the 2012/13 data in an explanatory model over the overall station ratings. The three most important station attributes in terms of their ability to explain the overall station rating were found to be cleanliness/graffiti, weather protection and platform seating. The analysis also looked to see how passenger profile affected the importance of station attributes. Retired passengers for example were found to attach more importance to platform seating. Females were more concerned about station lighting than males.

A space was provided at the end of the rating questionnaire for respondents to make comments. More than 1,100 passengers commented, with some providing useful suggestions for the NZ Transport Agency, regional transport authorities and bus and train operators to consider.

Overall, a flexible and cost-effective survey method was developed that could value changes in both vehicle and stop/station quality for both investment proposals and of a more operational nature.

There could be merit in surveying the smaller cities and towns of New Zealand and repeating the survey after major changes have been made (eg after Auckland electrification).

Abstract

The study looked at the trade-off between price and quality for bus and train users in Auckland, Christchurch and Wellington. After reviewing the literature, a survey of 12,557 bus and rail passengers on over 1,000 bus and train services was undertaken in 2012/13 using a stated preference (SP) and a rating questionnaire. The SP questionnaire presented a set of pair-wise choices. The rating questionnaire enabled valued vehicle and stop/station quality to be valued on a percentage scale from 0% (very poor) to very good (100%). The vehicle ratings were compared with 'objective' data such as bus age; the rail station ratings were compared with objective such as 'years since last refurbishment'; and the bus stop ratings were compared with perceived data on facility provision such as seating. A set of explanatory rating models were then developed, which in combination with the SP results, enabled vehicle and stop/station quality to be valued in terms of fare and in-vehicle time.

1 Introduction

1.1 Study aims

Douglas Economics and Associated Consultants was engaged by the NZ Transport Agency (Transport Agency) in December 2011 to provide willingness-to-pay values for public transport service level and quality and to develop a methodology to incentivise improvements from a customer, operator and funder perspective.

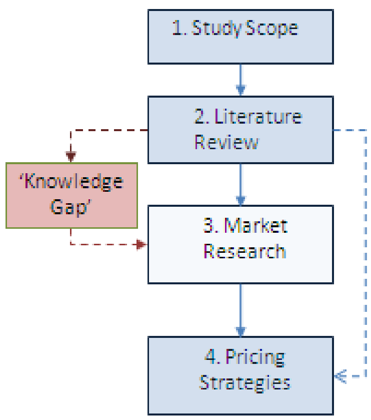
The research project had two main aims. First, produce willingness-to-pay values for public transport service level and quality attributes as absolute or percentage values of fare paid and disaggregate the values by demographic group and trip length (if absolute values are provided) and by time of travel (peak/off-peak) and establish the distribution of values that 'make up the average' to ascertain the proportion of passengers who are willing to pay more for each improvement.

Secondly, develop a methodology to assess the impact of bus and train improvements on public transport patronage and revenue and assess alternative strategies to incentivise quality improvements and their impact on patronage and identify the most appropriate ones for use in New Zealand taking into account distributional, equity, supply-side and practical considerations.

1.2 Overview

The project consisted of four key stages, as illustrated in figure 1.1.

Figure 1.1 Study stages



A scoping paper was prepared and a meeting held with the project steering group to agree what was in and out of scope for the project. Various options for the market research were also presented and it was agreed that a decision be taken following completion of the literature review (published separately in part 2 of this report) as to the form and extent of the market research.

The starting point for the literature review was the quality values given in the *Economic evaluation manual volume 2* (EEMV2) (NZ Transport Agency 2010b). The values were for bus and rail and were taken from the *National guidelines for transport system management in Australia* (ATC 2006, volume 4 – urban transport). The literature review sought to assess the list of attributes in the Australian Transport Council (ATC) study for completeness and review ways of describing and measuring the attributes.

Following the literature review, a market research plan was developed, proposing a two-part market research process. Part 1 was a self-completion rating questionnaire survey undertaken onboard trains and buses. Part 2 was a short stated preference (SP) survey of service level and quality improvement packages undertaken on trains and buses.

The market research plan had targets of 2,100 self completion questionnaires and 792 SP interviews. It also contained sample questionnaires and show cards, with attributes as determined from the literature review. However, following piloting of both the SP surveys, a decision was made to change the survey method from face-to-face interviews to self-completion. This resulted in increased targets of 2,600 rating questionnaires and 2,000 SP questionnaires. In the event, even these higher targets were massively overachieved with over 7,200 rating and 5,300 SP questionnaires obtained.

The development of pricing strategies for service level and quality improvements follows on naturally from the willingness-to-pay values and average fares estimated by the market research.

The following sections highlight the findings and/or decisions made as a result of the completion of the scoping, literature review and market research stages of the pilot. Full reports were written for each stage and were presented as separate reports.

1.3 Scoping report summary

The scoping report, prepared in February 2012, outlined the proposed scope and methodology of the study for discussion with the project steering group. While the market research approach was left undecided at this stage, the scope of patronage and services to be included in the study was agreed as discussed below.

1.3.1 Patronage and services

The focus of the study was people making public transport trips on buses and trains in Auckland, Wellington and Christchurch. People making car trips either as driver or passenger or walking/cycling were out of scope, as were ferry users and public transport users in other cities and towns. Thus, the two market research surveys only included the views of 'existing' public transport users.

Existing public transport users under age 15 were not deliberately surveyed although some did complete questionnaires. SuperGold Card users (available to people over 65 to travel free on buses and trains outside the peak period) were sampled like other passengers in the rating survey, but were not specifically targeted in the SP survey since they travel free. Again however, some SuperGold Card users travelling free did complete SP questionnaires and their response has been included and analysed. There was no specific targeting of people with disabilities.

Only intra-regional bus and rail service users (ie urban public transport users) were included in the study. Total mobility schemes were out of scope for this project, as were contracted/dedicated school services. All trip purposes were included (ie it was not be limited to commuting trips). The surveys included participant trips made at all times of the day and week, including Saturday and Sunday.

No maximum travel time was set for the study and to accommodate what was a wide range in travel times, several versions of the SP survey were developed that tailored the questions to trip length. Travel time was defined in terms of the bus or train time and excluded any access and egress time by walk or car and also any waiting time.

In terms of services covered, urban, suburban and longer distance urban-'rural' services in Christchurch, Wellington and Auckland were covered. In Wellington, the Wairarapa line was surveyed but not the bus services in the Wairarapa. The Capital Connection rail service running between Wellington and Palmerston North was not surveyed (although some station surveys undertaken in 2004 by Douglas Economics for

Tranz Metro have been included in the train station rating analysis). Hamilton and Auckland train and bus services were not covered.

The services surveyed were contracted subsidised services with one exception – the Wellington Airport Flyer service which is provided commercially (apart from the reimbursement of SuperGold Card passengers). The commercially provided Auckland airport express service to the CBD was not surveyed.

1.3.2 Public transport service level attributes

The request for proposals (RFP) stated that the 'research will look at different services improvements, including network improvements (eg increased frequency, longer hours of operation) and quality improvements (eg wifi, increased seat widths)'. The RFP suggested including network improvements (frequency and hours of operation). Accordingly, the SP survey included service frequency in the design and both the rating and SP surveys asked passengers about the frequency of their service and their waiting time.

As mentioned in section 1.2 the starting point for identifying the quality improvements to be included in the study was the EEMV2, which provides values for a list of around 50 bus and rail vehicle and infrastructure attributes. The values are expressed in travel time. Any market research would have to include only a subset of these.

One aspect of service quality that was not included in the RFP was service reliability which had been studied in detail by Vincent (2008). The survey did capture some passenger views on reliability, however, by having a 'comments section' at the end of the rating questionnaire.

The RFP did not identify crowding or capacity as a study attribute. Crowding at stations and onboard trains and buses will reduce the ability to take advantage of comfortable seats and other amenity improvements. That said, the rating questionnaire did specify seating in terms of availability as well as comfort. Moreover, the rating survey also included the 'ease of getting on and off' which also should factor in passengers' views of crowding. Otherwise, the quality values for vehicle and infrastructure quality presented in the report need to be considered as unaffected by crowding.

Access and egress times to public transport were considered out of scope, even though they could be considered as 'network' attributes. Facilities specifically for the disabled were also agreed as out of scope.

Transfer, the perceived penalty of having to change from one service to another, was not included in the RFP and was not included in the survey other than if raised by passengers in the comments section.

After consideration and in light of the findings of the literature review, driver/staff friendliness/availability was included as an attribute in the rating survey.

In-vehicle time (IVT) and fare were included in the SP survey as 'numeraires' to estimate willingness-to-pay valuations expressed in both IVT and minutes or dollars. A valuable by-product of the study was the estimation of the value of IVT for bus and train. In addition, the study also estimated the value of service interval.

Trip length was considered to affect the valuation of vehicle quality as passengers making a long bus journey are more likely to value air conditioning for instance than passengers making a short 'hop' bus trip. Accordingly, the rating survey covered a wide variety of bus and train services and the SP questionnaires were tailored to reflect the travel times and fares made by respondents.

1.4 Literature review summary

The full literature review is published separately as part 2 of this report. It focuses on studies that estimate time-based or willingness-to-pay values for qualitative aspects of urban bus and rail services. The aspects of quality reviewed are categorised into eight groups, as listed in table 1.1.

Table 1.1 Attributes reviewed

#	Attribute
1	Bus and train 'vehicle' quality package
2	Bus stop and train station quality package
3	Vehicle design appearance, ambience and facilities
4	Stop design appearance, ambience and facilities
5	Information
6	Personal safety/security
7	Maintenance/cleanliness/graffiti removal
8	Staff availability/appearance/friendliness and performance

1.4.1 Studies reviewed

The starting point for the review was the tabulation of attribute values presented in the EEMV2. In fact, the values in the EEMV2 derive from a 2006 review by Booz Allen Hamilton (ATC 2006) which in turn relied heavily on values in the 2004 version of the Transport for London (TfL) *Business case development manual*[1]. The London values were based on the Steer Davies Gleave (SDG) SP surveys undertaken in 1995 and 1999 which are cited in Bristow and Davison (2009). Thus, to a large degree, the values for bus relate to market research undertaken in London around 15 years ago.

A total of 13 studies were reviewed covering two decades and dating back to a SDG (1991a) survey of Wellington public transport services. It should be noted that some of the studies cited contain an element of review and so more than the 13 studies listed were covered by the review.

Three studies covered bus and rail services, five covered bus only and five covered rail only.

Two New Zealand studies were reviewed: an SP survey of bus and rail service quality undertaken by SDG in Wellington in 1991 (SDG 1991a) and a 2002–2005 survey of Wellington train station quality undertaken by Douglas Economics (Douglas Economics 2005).

Five Australian studies, three UK studies, one US study and one Norwegian study were also reviewed. Wherever possible, the original study methodology reports were reviewed so as to inform the design of the proposed market research.

None of the studies were undertaken to help develop pricing strategies; they were either related to forecasting demand such as providing input parameters into demand forecasting models or to help evaluate service improvements. As a consequence, none of the studies provided results that were directly useful in developing pricing strategies.

[1] The TfL *Business case development manual* has subsequently been updated. At the time of writing (June 2012) the latest version on the web was 2008. The current online version is dated 2013.

In terms of methodology, most of the studies used SP rather than revealed preference (RP) data (ie based on actual patronage response). The Wellington rail study used a priority evaluator approach, which presented a shopping list of service improvements for the respondents to choose from. By including a fare reduction or a travel time saving in the list, the valuation of the quality attributes could be established. The reported valuations for most of the studies were converted into either equivalent minutes of on-board bus/train time (IVT) or the percentage of the average fare paid.

Table 1.2 Studies reviewed[(a)]

#	Study	Reference	Location	Modes covered	Year of survey	Label
1	The effects of quality improvements in public transport	Steer Davies Gleave (SDG 1991a)	Wellington, New Zealand	Bus and rail	1991	SDGWTN
2	Values for rail service quality	Pacific Consulting (PCIE 1995)	Sydney, Australia	Rail	1995	SYDRI95
3	Liverpool to Parramatta transitway feasibility study	PPK Environment & Infrastructure (PPK 1998)	Sydney, Australia	Bus	1998	SYDTW
4	Developing a bus service quality index	(a) Hensher and Prioni (2002) and (b) Hensher et al (2003)	Sydney, Australia	Bus	1999–2002	HenBS
5	Valuation of improved railway rolling stock: a review of the literature and new evidence.	Wardman and Whelan (2001)	UK	Rail	Pre 2001	UKRS
6	Survey of rail quality – Dandenong Victoria	Halcrow (2005)	Victoria, Australia	Rail	2003	RQVIC
7	Values for rail service quality using ratings	Douglas and Karpouzis (2006a)	Sydney, Australia	Rail	2004/5	SYDRI04
8	Tranz Metro Wellington station quality survey	Douglas Economics (2005)	Wellington, New Zealand	Rail	2002 & 2004/5	WTNRST[(b)]
9	London bus and train values – 1995, 1999 and 2007 surveys	SDG, cited in Bristow and Davison (2009), Balcombe et al (2004) and ATC (2006)	London, UK	Bus and rail	1995–2007	SDGLND
10	Values for a package of bus quality measures in Leeds	Evmorfopoulos (2007), cited in Bristow and Davison (2009)	Leeds, UK	Bus	2007	LDSBQ
11	The role of soft measures in influencing patronage growth and modal split in the bus market in England.	AECOM (2009)	UK provincial cities	Bus	2009	AECOMBS
12	Valuing premium public transport services in the US	Outwater et al (2010)	US cities	Bus and rail	2010	USPT
13	Passengers' valuations of universal design measures in public transport	Fearnley et al (2011)	Norway cities	Bus	2007	NORPT

Sources: Balcombe (2004); Australian Transport Council (2006); Bristow (2009); Litman (2008)

[(a)] See the literature review (published separately as part 2 of this report) for a more detailed description of the studies reviewed. [(b)] Not previously reviewed.

Where only fare or IVT values were provided, an ‘external’ value of time was used. This was the case in the 2004 Sydney rail rating-based study (Douglas and Karpouzis 2006a) which used a value of time estimated by a contemporary SP survey (Douglas Economics 2004a). For other studies, a value of time referenced in the report was used, eg 2007 London bus valuations (9) or was taken from a known source, eg the Wellington train station survey (8) for which the EEM volume 2 (NZ Transport Agency 2010a) value of time was used.

All the studies presented average valuations. Six studies segmented the results by either trip length or by time period (or both) but seven studies only provided average valuations. Some studies explored the effect of user and trip profile on the valuations, but none reported valuations by market segment.

The strongest evidence for willingness to pay increasing with trip length was provided by the 2004 Sydney rail rating study (7). For bus, there was no strong evidence reported for valuations to increase with trip length.

None of the studies provided a willingness-to-pay profile that gave the percentage of respondents willing to pay more than a certain amount for the provision of an attribute or an improvement in service. This lack of detail reflects the orientation of the studies. Considered the closest in specification to producing a willingness-to-pay profile was the 1991 Wellington study (1), which asked passengers directly if they were willing to pay a higher fare for their preferred choice. Unfortunately only the average willingness to pay was reported.

Four studies surveyed non-users as well as users of the service (1,3, 11 and 12) with the results suggesting that car users valued service quality higher than bus or train users.

1.4.2 Package value versus sum of individual attribute values

The literature review (published separately as part 2 of this report) found mixed results regarding the issue of whether the value of an improvement package comprising several attributes was greater or less than the sum of the individual attribute values. To a large extent, however, the estimated package effects reflected the survey designs. Section 1.7 of the literature review describes the package effect in more detail and comments that the size of the package effect and the SP survey technique can be related.

The most extreme package effect was the US study of premium transit (12) which found that the sum of the individual attribute valuations estimated by a detailed ‘MaxDif’ SP was 10 times greater than the package quality value estimated by an overall mode choice SP experiment of bus vs rail vs car. By contrast, Wardman and Whelan (5) estimated a package effect of 0.5 in their analysis of SP/RP studies of UK rolling stock refurbishment, whereby the sum of the individual effects associated with ride quality, seating layout, seating comfort, noise, ventilation and ambience as estimated by SP studies needed to be halved to get the overall package value.

The 1995 SDG London bus SP survey (9) used to develop values for the TfL (2008) *Business case development manual*, estimated a value for passengers’ ideal package of 26 pence which was regarded as a willingness-to-pay cap. However, the sum of the SP attribute values totalled around £1.

The Norwegian study of bus/tram stop facilities (13) asked transfer price questions of the package of improvements which gave a value that was only a quarter of the sum of the attribute values estimated by the SP.

Two studies estimated a contrary package effect whereby the value of the sum of the individual attributes was less than the package effect. The Sydney rail study (7) estimated a package effect of 1.17 for trains and also for stations by comparing the forecast-value of improving the overall rating with the individual attribute ratings.

The AECOM study (11) was undertaken in 10 corridors in provincial UK cities. AECOM compared the sum of attribute valuations with the package SP estimate and found the package effect to be 10% higher than the sum of parts estimate.

1.4.3 Values of vehicle/carriage packages

The highest package values were estimated by Hensher and Prioni (2002) (4a) from a 1999 survey of bus users. The vehicle package offering wide entry doors, very clean and smooth buses and very friendly drivers was valued equal to 32 minutes of travel time or 90% of fare.

Next highest was the AECOM study (11) which estimated a value of 14.8 minutes (27% of fare) for a bus quality package including new low floor buses, with climate control (air conditioning), trained drivers, on-screen displays, audio announcements, CCTV, leather seats, customer charter and in-vehicle seating plan.

The US study of premium bus services (12) estimated lower package values of between 3.1 to 5.8 minutes. However, the package covered fewer attributes: wifi, on-board seating availability, seating comfort, temperature control and vehicle cleanliness. For rail, the package value was estimated to increase with trip length (0.13 minutes per minute of on-board train time).

The values for London included in TfL (2008) were lower when expressed in terms of travel time at 2.4 minutes for bus and 3.6 minutes for rail but higher in terms of fare (73% and 50%). It should be noted that the values were estimated in terms of fare and were converted as part of this review into minutes by applying an externally derived value of time.

The EEMV2 package values were reasonably exhaustive in terms of attributes covered but were not halved as recommended in the ATC guidelines (ATC 2006). The estimated value of 5.4 minutes for the bus improvement package was similar to the US public transport study but was only half the AECOM value. The rail improvement package at 11.4 minutes was higher than the other estimates.

1.4.4 Values of stop/station packages

In the studies reviewed, it was unclear whether the bus stop and train station values applied to just the board stop or to both the board and alight stops (ie the values were an average for the two stops).

For bus, most of the value was likely to be for the board stop because that is where passengers spend most of their time (waiting for a bus). Virtually no time is spent at the alight stop. However, city centre bus stations may add value through the provision of facilities. Also, the return trip reverses the board and alight stations.

For train stations, amenities and ambience offered at an alight station were more important. These included ease of getting off the train, alighting the platform, attractiveness/lighting of the accessways and concourse and the ease of exiting the ticket barriers. There were also interchange stations to consider where passengers both alighted, moved around the station and waited for trains.

Only the 1995 Sydney rail study (2) made explicit reference to the number of stations factoring down the values by the average number of stations used per trip (2.1). By contrast, the Sydney rating study (7) asked about the board station, and the Wellington station rating study (8) asked about either the board or alight station.

Like the vehicle package values, the composition of the packages varied which makes comparisons difficult. Some included information such as the two Hensher studies (4a and 4b). The US study (12) included personal security whereas others were limited to weather protection, seat provision, lighting etc.

The highest package value was worth 44 minutes estimated using the priority evaluator for the redevelopment of a station in Wellington (8). Again, the high value resulted no doubt from focusing attention on station improvements.

The value estimated by a Norwegian study (Fearnley et al 2011) of nearly 14 minutes for bus stops with weather protection and seating versus no provision was the second highest valuation. Again, focusing attention on bus stop facilities, probably overestimated the valuation.

The London 2007 surveys (9) estimated low values when expressed in an IVT of 1.9 minutes for improving bus stops from worst to best and 3.6 minutes for train stations. Higher values were produced when expressed in the fare. The Dandenong priority evaluator (6) survey produced similar results of low IVT values but high fare values.

The EEMV2 values of 4 minutes for a full package of bus stop improvements and 7 minutes for a train station were towards the lower end of the estimates.

1.4.5 Factors influencing individual attribute and package values

The studies gave a wide range for the value of bus and train improvements. Five factors were considered to have contributed to this.

First, measuring the value of quality improvements in terms of on-board time or percentage fare appears to have a major bearing on the relative valuation. Second, aside from making ‘like-for-like’ comparison very difficult, differences in package composition affect the valuation. Particularly important were whether ‘on-going’ aspects such as cleanliness, graffiti, staff friendliness, driver performance, announcements were included. For the SDG Wellington study (1), New South Wales (Australia) transitway study (3) and UK rail refurbishment report (5) only design factors were included thus the valuations were lower. Third, the method of estimation also affects the valuations with SP and rating valuations tending to be lower than the priority evaluator and transfer price estimates. Fourth, how the value was calculated affected the valuation; that is, whether it was a package presented to respondents or whether it was a package value calculated by adding attribute values. If it was the former, the package value was often constrained to an ‘assumed’ maximum. Fifth, the ‘base’ from where the improvement was measured was important. Differences in base quality, fare, travel time and trip profile influenced the valuation.

1.4.6 Overall conclusions

Of the studies reviewed, the system-wide survey of Sydney rail users (7) which used a rating survey and a ‘what if’ questionnaire to derive valuations, was the most promising enabling quality to be measured, unpacked and explained from a passenger perspective. The other studies valued individual attributes such as ‘no steps versus one step to board’ and then constructed ‘package’ values by addition. In doing so, the resultant valuations were often large and required downwards adjustment.

It is considered that the Sydney survey (7) could be improved by replacing the ‘what if’ question with a SP survey to establish the willingness to pay of passengers for varying levels of bus/train and stop/station quality as perceived by them through a rating score.

1.5 Analysis of Gravitas Auckland customer satisfaction survey

Auckland Transport (AT) provided the report (Gravitas 2011) and the raw data from two customer satisfaction surveys undertaken by Gravitas of bus, train and ferry passengers in May 2010 and October

2011. The survey data was then analysed by Douglas Economics to assess the extent to which passengers' overall rating could be explained in terms of their individual attribute ratings.

Only the train and bus responses were analysed which provided 4,261 responses (2,925 bus and 1,336 rail). The Gravitas questionnaire covered stop/station, bus/train, information, service and Auckland public transport in general. Only stop/station, bus/train and information were analysed. A six-point rating scale was used: 1 dreadful, 2 very poor, 3 poor 4 good, 5 very good and 6 excellent. There was no middle point. After giving the verbal descriptions in the question 'header', the labels were omitted with only the 1–6 scale shown (at equal distances). A NA column was provided on the left for 'don't know/not applicable'.

Most bus respondents rated the service good to excellent with relatively few giving a dreadful or poor rating. Less than 2% gave a NA answer. The average rating (excluding NA) ranged from 60% for shelter to 78% for easy location and bus boarding.

Regression analysis was used to explain the overall rating of the bus stop in terms of the individual attribute ratings. All the attribute parameters were estimated with reasonable precision and had correct sign. The most important attribute was cleanliness accounting for 22% of the overall rating followed by personal safety at 17%, ease of location and shelter (15%). Ease of boarding, seating, graffiti and information were less important accounting for 7% to 8% each.

The questionnaire also asked about the facilities provided at the bus stop (whether there was signage, a timetable, RTI, a seat and a shelter) and this data was used to explain the ratings. The rating of information increased from 55% to 71% when a timetable was provided at the bus stop and RTI increased the rating from 62% to 71%. Providing a seat increased the seat rating from 57% to 65% and a shelter increased the rating from 48% to 67%. The overall stop rating was then fitted to the bus stop data. The average rating without information, seating, shelter or signage was 64%. The provision of shelter increased the stop rating the most by 7%. RTI increased the rating by 5%, a timetable by 3% and seating by 1% but perversely, the provision of signage lowered the rating by 3%. Thus for the most part, information, seating and weather protection did not have a major role in explaining the overall bus stop rating.

For the bus vehicle, the ratings ranged from 67% for cleanliness/graffiti to 78% for ease of boarding.

The most important explanatory attribute of the overall rating was cleanliness at 19% followed by pollution (emissions) at 18% and comfort (17%). The survey categorised the buses on which the survey was undertaken into 'new' or 'old'. Most of the questionnaires (83%) were completed by passengers travelling on new buses with 10% on old buses and 7% on unclassified buses. New buses achieved an overall rating of 75% which was 5% points higher than old buses (70%). The higher rating was consistent across the individual attributes except for seating where both new and old achieved the same rating.

For the train station, 91% gave a good to excellent rating with very few not giving a rating. The station attribute ratings ranged from 66% for seating to 79% for ease of boarding the train with an overall rating of 76%. As for bus stops, cleanliness was the most important attribute (27%) in explaining the overall rating. Second was 'easy location' at 19%. Safety, seating, shelter and graffiti each explained 13% to 10%. Least important was information and ease of boarding at 3% to 4%.

The overall rating of the train was 74% with attribute ratings ranging from 68% for cleanliness to 79% for ease of boarding and alighting. There was little difference between the top five explanatory attribute ratings with inside cleanliness (explaining 18%) graffiti (18%) comfort (17%) and ease of alighting (16%) and seating (15%). Information had a relatively low importance of 5% (which was probably due to the attribute being included under a different heading on the questionnaire). Outside cleanliness (6%) and ease of boarding (5%) were also of relatively low importance.

The analysis of the AT data confirmed that it was possible to develop explanatory models of passenger ratings of vehicles and stops. The surveys provided large samples and similar large samples and given the analysis results, similar sized samples would be required.

The survey included personal safety as an attribute for the bus stops and train stations. However it was not proposed to include safety as an individual attribute in the pricing strategies rating survey but instead to allow perceptions to influence the overall rating.

The surveys included 'ease of getting to the stop/station'. While important, bus stop/train station location can be regarded as 'fixed'. Moreover, valuing walk/drive time was not an attribute identified by the steering group and accordingly the attribute was not included in the pricing strategies questionnaire.

Pollution was included in the bus vehicle rating but not in the train rating. Pollution explained 18% of the overall bus rating with new buses having a 6% point higher pollution rating than old buses. For the pricing strategies study, it was decided to include pollution (emissions/noise) on both the bus and train questionnaire.

Information ratings were included under a separate grouping of attributes on the AT questionnaire. For analysis, the information ratings were used to explain the stop/station and bus/train ratings. However, the relative importance was low and this is considered to have resulted in part from the separate grouping. The pricing strategies questionnaire will include information on both the stop/station and vehicle attribute lists.

As well as providing guidance to develop the main rating questionnaire, the results of the AT customer satisfaction survey provide a comparison with the results of the pricing strategies survey. Some comparisons are made in sections 5 and 6.

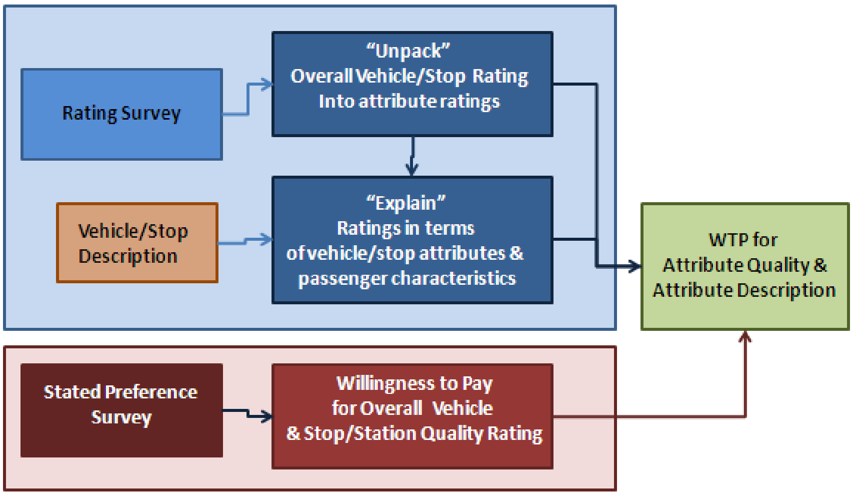
1.6 Preferred study methodology – a hybrid rating and stated preference survey

The preferred methodology that emerged from the literature review (published separately in part 2 of this report) and from assessment of the Auckland customer survey was a hybrid approach involving two types of survey: a rating survey and a SP survey. The hybrid approach is shown in figure 1.2.

The rating survey would aim to measure the quality of service from a passenger perspective. With a large enough sample size that collectively covered the range of buses and trains, bus stops and stations in Auckland, Christchurch and Wellington, analysis could reveal the relative importance of individual attributes such as cleanliness, seating and driver friendliness. Moreover, by linking the ratings to data such as the age of the bus, the number of seats and the type of the bus, eg trolley bus or diesel and to bus stop facilities and also train station data, the survey data could be explained in terms of objective data and thus used to develop models for forecasting and evaluative purposes.

The SP survey would present choices to bus and rail passengers in which vehicle quality and stop/station quality was described using a passenger rating score and varied alongside fare, service frequency and onboard travel time. In this way, the willingness to pay for vehicle and stop quality in terms of fare and onboard time could be established. Moreover the survey, by covering short, medium and long trips and also low, medium and high-frequency services, could explore the relationship between vehicle quality and onboard time and bus stop and train station quality and waiting time.

Figure 1.2 Preferred market research approach



1.7 The pilot survey

Pilot surveys were undertaken in October and November 2012 in Wellington. The pilot surveys tested the questionnaire content and the method of surveying.

The rating survey was designed as a self-completion questionnaire and was found to work well on an A5 sized card printed front and back. Some improvements were made to the layout, to the wording of the questions and to the list of attributes. Following piloting, it was decided to add two vehicle ratings to the original list: (1) 'ability to use computers, internet connectivity – wifi' and (2) environmental impact, eg emissions (for reasons given in section 1.4). The 'general design and layout' attribute was removed since this attribute was very similar to the 'overall rating' of the vehicle.

Four versions of the SP questionnaires were piloted by face-to-face interview onboard Wellington trains. The aim was to see whether interviewing was possible on trains, how people viewed the content of the questionnaire and whether or not they would be able to complete the questionnaire on their own. People understood what they were required to do and after explaining the first choice most passengers could complete the exercise on their own. In terms of method, however, it was found difficult to interview on busy moving trains and it was even more difficult on buses. Therefore, a self-completion questionnaire was developed with a short written instruction. The survey was tested on five bus services and worked well. As noted earlier, the change to a self-completion SP questionnaire enabled a higher sample size to be achieved.

1.8 Report structure

The report is structured in three parts: part 1 presents the results of the main survey, part 2 contains the full literature review and part 3 contains the appendices. Parts 2 and 3 are published separately. The rest of part 1 is as follows:

Chapter 2 gives details of the survey including sample sizes by city, mode, operator, route and stop/station.

Chapter 3 presents the profile of the respondents for the rating and SP surveys.

Chapter 4 presents a profile of the travel time and cost components of the two surveys, including onboard travel time; number of minutes between departures, wait time, ticket types and fare.

Chapter 5 presents the findings of the bus and train 'vehicle' ratings including models that explain the overall vehicle ratings.

Chapter 6 presents the bus stop and train station ratings and develops explanatory models of stop/station quality. For Wellington rail, a powerful 'before and after' type analysis was undertaken that compares the station ratings in 2002–04 with those in 2012 in the context of whether or not any upgrading had occurred at individual stations. The earlier 2002–04 data is also added with the 2012 data to explain the overall rating in terms of the attribute ratings.

Chapter 7 analyses the SP choice questions and presents travel time and willingness-to-pay values for travel time, service frequency, vehicle quality and stop/station quality

Chapter 8 provides a descriptive analysis of the verbatim comments gathered through the ratings questionnaires for Auckland, Wellington and Christchurch bus services and Auckland rail. The analysis enabled the study scope to be widened to look at all aspects of bus and train service, including reliability and ticketing from a passenger perspective.

Chapter 9 presents conclusions and recommendations.

Chapter 10 contains a list of works cited in the report.

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2 Survey details and sample sizes

2.1 Introduction

This chapter describes the profile of the survey presenting tabulations on the number of interviews and services surveyed by type (section 3.2), city (3.3), mode (3.4), month (3.5), day of week (3.6) and time period (3.7), by peak and off-peak period (3.8). Section 3.9 looks at the bus and train routes that were surveyed and finally in section 3.10, the bus and train operators who were surveyed are listed.

2.2 Questionnaire content

The rating questionnaires consisted of two parts: rating questions and socio-economic, demographic and trip profile questions. The SP questionnaire featured a set of choice questions, some rating questions and socio-economic, demographic and trip profile questions. The content of the two surveys is listed in table 2.1.

The rating attributes, listed at the top of the table covered stop/station and vehicle. The SP included travel time, fare, service interval, vehicle quality and stop/station quality attributes.

Respondents were also asked a set of trip and socio-economic questions. Questions included the stations used; the trip purpose; employment, occupation and age group. There were differences in the bus and rail rating questionnaires to take account of the difference stop and station attributes.

Fieldworkers also recorded details of the bus or train, the time and weather conditions. The response to these questions enabled the profile of the samples to be assessed and used to explain the response to the SP and rating questions. These variables are summarised in table 2.2.

For train stations, Greater Wellington Regional Council (GWRC) and AT provided details on the refurbishment/rebuild programmes they had undertaken.

For Wellington, two earlier rating surveys undertaken in 2002 and 2004 by Douglas Economics (2005) for Tranz Metro enabled a 'before and after' analysis to be undertaken with the added advantage of 'control stations where no improvements had been undertaken but for which passengers ratings were collected.

Table 2.1 Questionnaire content

Attribute	1 – Rating questionnaire	2 – Quality SP
Bus stop features	✓[a]	
Stop/station rating	✓	✓
Stop/station attribute ratings	✓	
Vehicle rating	✓	✓
Vehicle attribute ratings	✓	
SP – onboard travel time		✓
SP – fare		✓
SP – service interval		✓
SP – station/stop quality		✓
SP – vehicle quality		✓
Ticket type		✓
Fare concession entitlement		✓

Attribute	1 – Rating questionnaire	2 – Quality SP
Fare paid		✓
How often use service	✓	
Board stop/station	✓	✓
Alight stop/station	✓	✓
Access mode to board station	✓[(b)]	
Egress mode from alight station	✓[(c)]	
Wait time at station/stop	✓	✓
Service frequency	✓	✓
Onboard travel time	✓	✓
Trip purpose	✓	✓
Age group	✓	✓
Gender	✓	✓
Employment status	✓	✓
Occupation (verbatim)	✓	✓
Personal income group		✓
Comments	✓	
Email address for further survey	✓	

Notes: [(a)] on bus rating survey only; [(b)] only asked on rail questionnaires; [(c)] only asked on outbound (rail) questionnaires

Table 2.2 Survey data

Attribute	Description
Service number	Unique identification on 'envelope' number for each service surveyed.
Route number	Service route number, code or rail line.
Month of survey	Date of survey was recorded and processed as month of survey.
Day of week	Day of week survey was undertaken.
Time of survey	Time of survey was recorded and processed as AM peak (before 09.30, off-peak (09.30–16.30), PM peak (16.30–18.30) and evening (after 18.30).
Light	Based on date and time, whether survey was undertaken when it was dark or light.
Raining	The weather was summarised by fieldworkers and coded into whether it was raining (or drizzling) when the survey was undertaken.
Windy	Whether there was a strong wind or whether it was calm.
Bus vehicle identification number	Number on side and inside front of bus indentifying vehicle.
Bus operator	Based on vehicle branding, route number and bus vehicle identifier number.
Vehicle age (years)	Survey date minus date of first registration in New Zealand. For trains, the number of years since last major refurbishment was estimated.
Seats	Number of seats on bus or train carriage.
Bike carry	Whether the bus/train was able to carry bicycles.
Aircon	Whether the bus/train had air conditioning.
Super low floor	Whether the bus was super low floor

Attribute	Description
Wheelchair accessible	Whether the bus/train was wheelchair accessible.
Engine 'Euro' rating	Euro rating of the bus engine noting whether pre-Euro or whether bus was an electric trolley bus.
Train station data	Facilities available at train stations in Auckland and Wellington
Wellington train stations upgrade	Improvements made to Wellington stations since 2002.

2.3 Sample sizes

A total of 12,557 questionnaires were completed: 7,201 (57%) rating questionnaires and 5,356 SP questionnaires (43%).

Table 2.3 Overall sample sizes

Survey	Completed questionnaires	Percent
Rating	7,201	57%
SP	5,356	43%
Total	12,557	100%

A total of 1,082 different bus and train services (individual trips) were surveyed. On most services, rating and SP questionnaires were handed out. On some services however, only one of the questionnaires was distributed.[2] On average, 12 questionnaires were completed on each bus or train.

A total of 1,385 questionnaires, accounting for 11% of the sample, were completed on 157 Christchurch buses. In Wellington, 5,905 questionnaires were completed, accounting for 47% of the sample, on 458 buses and trains. Finally, in Auckland, 5,271 questionnaires, representing 41% of the sample, were completed on 467 buses and trains.

Table 2.4 Questionnaires completed

Survey	Completed questionnaires			Total
	CHC	WTN	AUC	
Rating	595	3,575	3,031	7,201
SP	790	2,326	2,240	5,356
Total	1,385	5,901	5,271	12,557
Survey	**Services surveyed**			**Total**
	CHC	**WTN**	**AUC**	
Rating	82	354	427	863
SP	134	340	384	858
Total[(a)]	157	458	467	1,082
[(a)] Total is less than sum of rating + SP because both types of survey were undertaken on most services				

[2] As a result, as table 2.4 shows, the number of different bus and train services surveyed was less than the combined sum of rating and SP services surveyed.

Survey	Questionnaires per surveyed service			Total
	CHC	WTN	AUC	
Rating	7	10	7	8
SP	6	7	6	6
Total[(b)]	9	13	11	12

[(b)]Total is not the sum of rating + SP because both types of survey were undertaken on most services

Note: CHC = Christchurch; WTN = Wellington; AUC = Auckland. Abbreviations used in tables through the report; WEL is also used for Wellington.

Table 2.5 presents the samples obtained for bus and rail for each city. For bus, a total of 9,166 questionnaires were completed on services. For rail, 3,411 questionnaires were completed on 269 services.

On average, 12 questionnaires were completed per surveyed service with a slightly higher average on train services (13) than bus services (11).

For bus, an even split of rating and SP questionnaires was obtained. For rail, around 70% were rating questionnaires and 30% SP questionnaires. The larger number of rail rating questionnaires was necessary to provide sufficient data to explain individual stations.

Table 2.5 Surveys by mode

Survey	Completed questionnaires							
	CHC bus	WTN bus	AUC bus	WTN rail	AUC rail	Bus	Rail	Total
Rating	595	2,337	2,192	1,238	839	5,124	2,077	7,201
SP	790	1,383	1,869	943	371	4,042	1,314	5,356
Total	1,385	3,720	4,061	2,181	1,210	9,166	3,391	12,557
Survey	**Services surveyed**							
	CHC bus	WTN bus	AUC bus	WTN rail[(b)]	AUC rail[(b)]	Bus	Rail[(b)]*	Total
Rating	82	232	301	122	126	615	248	863
SP	134	205	307	135	77	646	212	858
Total[(a)]	157	272	384	186	83	813	269	1,082
[(a)]Total is less than sum of rating + SP because both types of survey were undertaken on most services [(b)] Some rail services had two surveyors who returned questionnaires separately								
Survey	**Questionnaires per surveyed service**							
	CHC bus	WTN bus	AUC bus	WTN rail	AUC rail	Bus	Rail	Total
Rating	7	10	7	10	7	8	8	8
SP	6	7	6	7	5	6	6	6
Total[(c)]	9	14	11	12	15	11	13	12

[(c)] Total is not the sum of rating + SP because both types of survey were undertaken on most services

2.4 Surveys by month

The pilot surveys were undertaken in Wellington between 17 October 2012 and 2 November 2012.[3]

The main survey was undertaken between November 2012 and May 2013.

Table 2.6 shows the dates each city was surveyed. The main surveys started in Christchurch on 19 November 2012 and ran for three weeks to 12 December. During the last week, some bus routes were changed.

The main survey commenced in Wellington on 21 November 2012 and ended with a survey of Paraparaumu buses on Monday 10 December.

Auckland surveys were undertaken in two batches. All buses and some trains were surveyed during a three-week period commencing 9 February 2013 and ending on 12 March. The second tranche surveyed rail services commencing on 30 April and ending on 12 May 2013. Weekday surveys were undertaken between 30 April and 3 May 2013. The rail lines were closed on the weekend of 4–5 May so the weekend surveys were delayed until 11 and 12 May 2013.

Table 2.6 Fieldwork programme (2012–2013)

City	Oct 12	Nov 12	Dec 12	Jan 13	Feb 13	Mar 13	Apr 13	May 13
Wellington	17 Oct–2 Nov	21 Nov – 10 Dec						
Christchurch		19 Nov – 7 Dec						
Auckland					19 Feb – 12 Mar		30 Apr – 12 May	

Table 2.7 Surveys by month

	Oct 12	Nov 12	Dec 12	Feb 13	Mar 13	Apr 13	May 13	Total
Rating	78	1,365	2,727	380	1,599	183	869	7,201
Quality SP	120	1,276	1,720	581	1,444	60	155	5,356
Total	198	2,641	4,447	961	3,043	243	1,024	12,557

2.5 Surveys by day of week

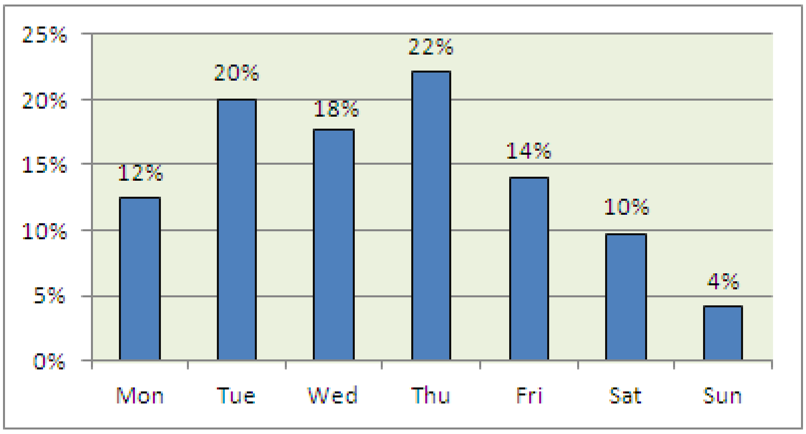
Surveys were undertaken on every day of the week. Most surveys were undertaken on Thursday (22%) followed by Tuesday (20%). Just over 1,700 surveys, 14% of the sample were completed on weekends; 1,224 surveys (10%) were undertaken on Saturday and 515 (4%) on Sunday.

Table 2.8 Interviews by day of week

	Mon	Tue	Wed	Thu	Fri	Sat	Sun	Total
Rating	747	1,600	1,275	1,736	818	652	373	7,201
Quality SP	812	912	943	1,036	939	572	142	5,356
Total	1,559	2,512	2,218	2,772	1,757	1,224	515	12,557

[3] The total includes 198 'pilot' questionnaires where some response data was useable (78 rating and 120 SP).

Figure 2.1 Share of interviews by day of week (%)



2.6 Time period

Surveys were undertaken through the day (6am to 10pm). The 'day' was divided into four periods: AM peak (before 9.30am), off-peak (9.30am to 4.30pm) PM peak (4.30pm–6.30pm) and evening (after 6.30pm).

Table 2.9 Interviews by time period

	Weekday				All
	AM pk	Off-pk	PM pk	Evening	
Rating	1,272	3,162	1,448	294	6,176
SP	1,017	2,374	949	302	4,642
Total	2,289	5,536	2,397	596	10,818
	Weekend				**All**
	AM pk	**Off-pk**	**PM pk**	**Evening**	
Rating	46	638	202	139	1,025
SP	55	427	121	111	714
Total	101	1,065	323	250	1,739
	Total				**All**
	AM pk	**Off-pk**	**PM pk**	**Evening**	
Rating	1,318	3,800	1,650	433	7,201
SP	1,072	2,801	1,070	413	5,356
Total	2,390	6,601	2,720	846	12,557

2.7 Peak/off-peak surveys by city

Questionnaires were completed during the weekday AM peak (before 9.30am) and PM peak (4.30pm to 6.30pm.

Overall, 37% of questionnaires were completed during the peak and 63% during the non-peak. The peak percentage was lowest in Christchurch at 17%, increasing to 33% in Auckland and was highest in Wellington at 46%.

There was little difference in the shares by questionnaire type.

Table 2.10 Interviews by time period

	Peak				Non-peak				Peak %			
	CHC	WTN	AUC	All	CHC	WTN	AUC	All	CHC	WTN	AUC	All
Rating	75	1,685	960	2,720	520	1,890	2,071	4,481	13%	47%	32%	38%
SP	162	1,021	783	1,966	628	1,305	1,457	3,390	21%	44%	35%	37%
Total	237	2,706	1,743	4,686	1,148	3,195	3,528	7,871	17%	46%	33%	37%

2.8 Bus and train routes surveyed

Appendix A (see part 3 of this report) presents the bus and train routes that were surveyed. For analysis purposes, the bus and train routes were aggregated as shown in table 2.11. Schematic maps of the Christchurch and Auckland bus routes are provided in appendices F and G respectively (see part 3 of this report). Schematic maps of the Wellington and Auckland train networks are provided in sections 6.17 and 6.19 respectively.

Twenty-four bus routes in Christchurch were surveyed which were aggregated into eight groupings.

Table 2.11 Bus and rail routes surveyed

#	City	Mode	Route	Rating	SP	Total
1	CHC	Bus	Orbiter	328	129	457
2	CHC	Bus	North – South (11,12,13,15,17,20)	69	75	144
3	CHC	Bus	N.East – West (5,7,60,Metro Star)	74	166	240
4	CHC	Bus	West – S.East (21,23,28)	12	56	68
5	CHC	Bus	N.East-West (40,45)	24	43	67
6	CHC	Bus	Airport Sumner (3,29)	83	120	203
7	CHC	Bus	Outer West/S.West (81–84, 88,820)	2	102	104
8	CHC	Bus	Far North (90)	3	99	102
1	WTN	Bus	Newtown,Island Bay,Happy Valley (1,4,10)	146	130	276
2	WTN	Bus	Uni/Mairangi (13,17,18)	76	49	125
3	WTN	Bus	Karori – L.Bay (3)	171	112	283
4	WTN	Bus	Miramar, Seatoun (2,11)	140	76	216
5	WTN	Bus	Wilton-Kilbirnie/Hataitai/Khandallah (5,14,43,44)	144	118	262
6	WTN	Bus	Mairangi/W.Hill, Mt Victoria (20–24)	117	104	221
7	WTN	Bus	Kingston/Kowhai Park/Aro Valley (7–9)	84	49	133
8	WTN	Bus	Eastbourne/Wainui (81,83,160,170)	74	113	187
9	WTN	Bus	Hutt Valley (110–150)	59	87	146
10	WTN	Bus	Churton Park/Johnsonville/Porirua (52–56,211)	133	190	323
11	WTN	Bus	Paraparaumu (250,260,262)	0	27	27
12	WTN	Bus	Airport Flyer (91)	91	190	281

#	City	Mode	Route	Rating	SP	Total
1	WTN	Rail	Johnsonville	443	143	586
2	WTN	Rail	Kapiti	863	528	1,391
3	WTN	Rail	Hutt Valley (including Melling)	847	298	1,145
4	WTN	Rail	Wairarapa	187	112	299
1	AUC	Bus	City Link,City Loop	22	90	112
2	AUC	Bus	Outer Loop	43	39	82
3	AUC	Bus	Northern Express	69	74	143
4	AUC	Bus	Central (5–11,20,30)	230	223	453
5	AUC	Bus	Central South (173–198)	57	46	103
6	AUC	Bus	West (48,49,80-97,104–163)	394	366	760
7	AUC	Bus	NW (220–233)	100	175	275
8	AUC	Bus	SW (258–287)	63	72	135
9	AUC	Bus	S.Manukau (300s)	186	175	361
10	AUC	Bus	Far S Papak (400s)	55	79	134
11	AUC	Bus	E Bot/Howick (500s)	155	174	329
12	AUC	Bus	E Glen I (600s)	50	21	71
13	AUC	Bus	Gl I v MisBay (700s)	65	65	130
14	AUC	Bus	CBD–N Shore (800-900s)	141	113	254
15	AUC	Bus	Intra N Shore (800-900s)	188	169	357
1	AUC	Rail	East Line	380	91	471
2	AUC	Rail	South Line	235	61	296
3	AUC	Rail	Onehunga Line	276	96	372
4	AUC	Rail	West Line	322	111	433
All	All	All	All	7,201	5,356	12,557

Some of the 24 routes were only surveyed once. Route 3 Airport – Sumner, 5 Hornby – Southshore and the Orbiter were surveyed more than 10 times each. It should be noted that some of the bus routes have been re-structured since the survey. Indeed, some routes were restructured during the survey. Thus some of the routes no longer exist or have changed.

Forty-one Wellington bus routes were surveyed covering Wellington, Johnsonville, Porirua, Kapiti and the Hutt Valley. Several services were only surveyed once and the samples are therefore low. Bus routes operating in the Wairarapa were not surveyed. Seven bus services were surveyed more than 10 times including the Airport Flyer service. For analysis purposes, the bus routes were aggregated into 12 groupings.

All four rail lines in Wellington were surveyed: Johnsonville, Kapiti, Hutt Valley (including the Melling line) and the long-distance Wairarapa rail line. The ‘Capital Connection’ Wellington–Palmerston North rail service was not surveyed.

In Auckland 123 individual bus routes were surveyed and these were grouped into 15 aggregated routes. Three bus routes were surveyed 10 or more times: route 957 (Highbury to Birkenhead Wharf), the City Outer Link and the Northern Express. The Auckland ‘Airbus’ Express service which is provided commercially was not surveyed, however, and nor were the Waiheke Island services (five routes) operated by Fullers bus company.

All four rail lines in Auckland were surveyed: East, South, Onehunga and West.

2.9 Bus and rail operators surveyed

Surveys were carried out on bus and train services operated by 15 companies of which 13 were bus operators and two were rail operators. Table 2.12 presents details of the sample by bus and train operator.

Table 2.12 Bus and rail operators surveyed

City	Mode	Operator	Rating q'aires	SP q'aires	Total q'aires	Services surveyed
CHC	Bus	Go Bus	42	212	254	25
CHC	Bus	Leopard Coach Lines	437	363	800	86
CHC	Bus	Red Bus	116	215	331	46
WTN	Bus	Go Wellington	878	627	1,505	154
WTN	Bus	Valley Flyer	187	240	427	54
WTN	Bus	Airport Flyer	37	161	198	16
WTN	Bus	Mana Coach Services	133	217	350	47
WTN	Rail	KiwiRail	2,340	1,081	3,421	187
AUC	Bus	Birkenhead Transport	228	178	406	56
AUC	Bus	Howick & Eastern	147	167	314	31
AUC	Bus	NZ Bus	1,179	1,263	2,442	248
AUC	Bus	Ritchies	164	181	345	36
AUC	Bus	Tranzit/Pacific Tourways	6	9	15	2
AUC	Bus	Urban Express	94	83	177	11
AUC	Rail	Veolia	1,213	359	1,572	83
All	All	Total (15)	7,201	5,356	12,557	1,082

In Christchurch, services operated by Go Bus, Leopard Coachlines and Red Bus were surveyed. 'Go Bus' Christchurch operated routes previously operated by Christchurch Bus Services under the 'Metro' brand. Leopard Coachlines operated the 'Orbiter' Selwyn Star and Urban Cat brands which were sold to Hamilton's 'Go Bus' in July 2013 (ie after the survey was undertaken). Red Bus operates the Metrostar, Airport services (Sumner, Fendalton and Cashmere) and other services.

In Wellington (excluding Wairarapa), two bus companies provided services: NZ Bus and Mana Coach Services. The latter operated services on the Wellington and Johnsonville/Porirua 'corridor' and also services in Kapiti. The former operated bus services in Wellington city under the brand names 'Go Wellington' and 'Airport Flyer' and services to and within Lower and Upper Hutt under the brand 'Valley Flyer'.[4]

In Auckland, two-thirds of the surveyed bus services were operated by NZ Bus under the brand names 'Northstar', 'Metrolink', 'Waka Pacific', 'Go West' and 'Link'. Of the remaining third, Birkenhead Transport,

[4] One Wilton-Kilbirnie bus service that was surveyed was operated by a bus branded in the Valley Flyer livery instead of the normal Go Wellington livery.

Howick and Eastern and Ritchies accounted for most (90%) of the surveyed services surveyed. Birkenhead Transport served Birkenhead, Birkdale, Beach Haven, Glenfield, Bayview and Highbury on the North Shore and linked these suburbs with Takapuna, Albany, Ponsonby, Newmarket, Auckland and Massey University Campuses. Ritchies operated the Northern Express Services on the Northern Busway. The other two operators were Urban Express (which operated to Blockhouse Bay, New Lynn and a few cross town services) and Tranzit/Pacific Tourways which operated the 380 Manukau to airport service (only two services were surveyed however).

3 Respondent profile

3.1 Introduction

This section describes the profile of bus and rail users who completed the rating and SP questionnaires.

The profile is described in terms of journey purpose (section 3.2) gender (3.3) age (3.4) employment status (3.5) occupation (3.6) income (3.7) and frequency of bus and train use (3.8).

The profiles are presented first by survey type; second by city, mode and time period; and third by route and time period.

Detailed tabulations by route are in provided in appendix B (see part 3 of this report).

3.2 Journey purpose

The journey purpose profile for the rating and SP surveys were similar as shown by table 3.1. Forty-five percent of questionnaires were completed by passengers commuting to/from work and 17% by passengers travelling to/from education. The percentage making personal business, shopping, visiting friends and relatives and entertainment trips was similar at around or just under 10% each. Relatively few questionnaires were completed by passengers making company business trips (1%) although the total (143) was sufficient to estimate rating and SP models for this trip category.

Table 3.1 Journey purpose profile by survey

Journey purpose	Number of responses			Percent of valid response		
	Rating	SP	All	Rating	SP	All
To/from work	3,206	2,311	5,517	46%	44%	45%
To/from education	1,082	961	2,043	15%	18%	17%
Personal business	669	533	1,202	10%	10%	10%
Company business	66	77	143	1%	1%	1%
Shopping	735	430	1,165	10%	8%	9%
Visiting friends/rels	560	483	1,043	8%	9%	8%
Entertainment/hol/sport	579	364	943	8%	7%	8%
Other	137	78	215	2%	1%	2%
Airport/ferry/Ldisttrain	8	11	19	0%	0%	0%
Total	7,042	5,248	12,290	100%	100%	100%

Figure 3.1 Journey purpose profile

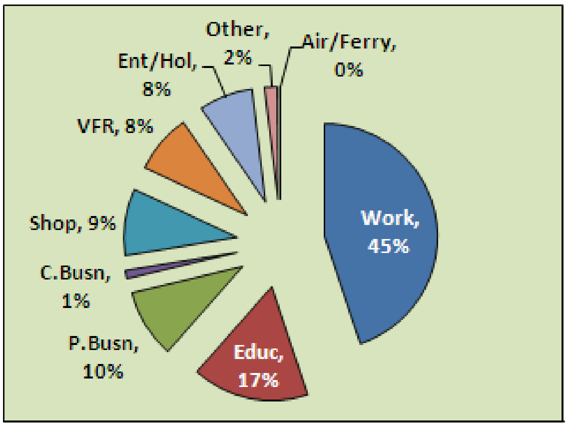


Table 3.2 presents the journey purpose share by city, mode and time period. Wellington rail had the highest percentage of respondents travelling to/from work with 84% in the peak and 39% in the off-peak (see figure 3.2). The work commuting percentage reduced to 64% on Wellington buses with Christchurch having the lowest shares (47% in the peak and 26% in the non-peak).

For Auckland, the work share of peak trips was 52% for buses and 64% for rail. For non-peak travel, the shares reduced to 29% and 21% respectively.

Table 3.2 Journey purpose profile by city and peak/non-peak period

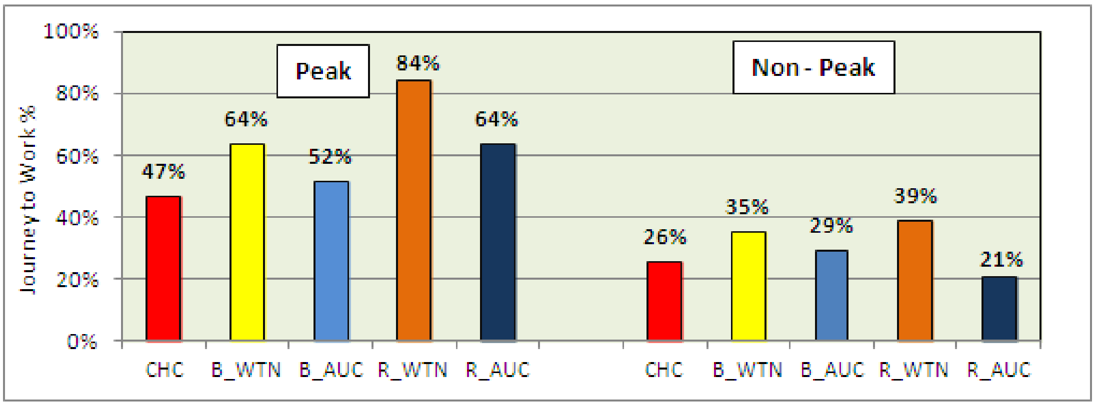
Journey purpose	Peak						Non-peak					
	Bus			Rail		All	Bus			Rail		All
	CHC	WTN	AUC	WTN	AUC		CHC	WTN	AUC	WTN	AUC	
To/from work	47%	64%	52%	84%	64%	68%	26%	35%	29%	39%	21%	31%
To/from education	19%	8%	31%	4%	23%	14%	13%	11%	31%	9%	21%	18%
Personal business	17%	9%	5%	3%	2%	5%	18%	17%	11%	10%	9%	13%
Company business	0%	1%	0%	2%	1%	1%	1%	2%	1%	2%	1%	1%
Shopping	6%	4%	4%	1%	3%	3%	23%	13%	10%	10%	17%	14%
Visiting friends/rels	6%	7%	4%	4%	4%	5%	11%	10%	9%	15%	9%	11%
Entert/hol/sport	3%	5%	3%	2%	4%	3%	6%	10%	8%	12%	22%	11%
Other	2%	2%	1%	1%	1%	1%	3%	2%	2%	3%	1%	2%
Airport/ferry/train	0%	1%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%
Valid response	231	823	1,114	1,863	600	4,631	1,111	1,609	2,448	1,537	954	7,659

Surveyors were asked not to hand out questionnaires to passengers they judged to be under 12 to accord with market research protocol, thus the education share was underestimated. It should also be noted that for Wellington and Christchurch, the surveys were undertaken when universities and polytechnics were on holiday.

Auckland had the highest percentage of peak respondents travelling to/from education at 31% on buses and 23% on trains. For Wellington, the education share was only 4% for peak trains and for Christchurch, the percentages were 19% in the peak and 13% in the non-peak periods.

Nearly a quarter of Christchurch non-peak respondents were making shopping trips which probably reflected the high sampling of the Orbiter service which connects the shopping malls. The percentage was double the non-peak share for Wellington and Auckland. The share of passengers making personal business trips was also higher in Christchurch at 17% to 18% in the peak and non-peak than in Wellington and Auckland where the peak share was 4% to 5% and the non-peak was 10% to 13%.

Figure 3.2 Percentage commuting to work by city by peak/non-peak period



Appendix B, table B.1 (see part 3 of this report) presents the journey purpose profile by aggregated route for the peak and non-peak period. The tabulation shows the sample sizes to be reasonable (exceeding 20) for all but four route peak/non-peak aggregations. Differences in the journey purpose profile were identified across the routes that probably contributed to response differences in the stop and vehicle ratings and also in the response to the SP questions.

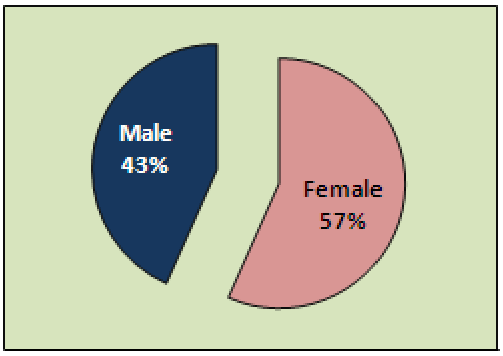
3.3 Gender

More females than males completed the survey. Overall, 57% of the questionnaires were completed by females and 43% by males. The gender profile for the rating and SP surveys was nearly identical as can be seen in table 3.3.

Table 3.3 Gender profile by survey

Gender	Number of responses			Percent of valid response		
	Rating	SP	All	Rating	SP	All
Female	3,840	3,012	6,852	56%	57%	57%
Male	2,978	2,262	5,240	44%	43%	43%
All	6,818	5,274	12,092	100%	100%	100%

Figure 3.3 Gender profile – all responses



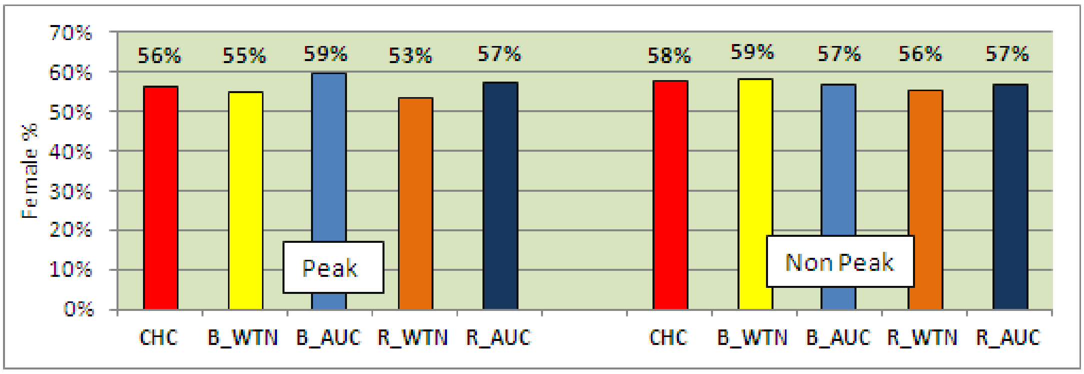
There was also little difference in the gender profile by city, mode and time period. Female respondents ranged from a low of 53% on Wellington peak trains to a high of 59% on Auckland peak buses and on Wellington non-peak buses.

Table 3.4 Gender profile by city and peak/non-peak period

Journey purpose	Peak						Non-peak					
	Bus			Rail		All	Bus			Rail		All
	CHC	WTN	AUC	WTN	AUC		CHC	WTN	AUC	WTN	AUC	
Female	56%	55%	59%	53%	57%	56%	58%	59%	57%	56%	57%	57%
Male	44%	45%	41%	47%	43%	44%	42%	41%	43%	44%	43%	43%
Valid response	227	823	1,114	1,842	562	4,568	1,093	1,586	2,473	866	2,372	7,524

Appendix B, table B.2 (see part 3 of this report) presents the gender profile by aggregated route for peak and non-peak periods.

Figure 3.4 Percentage female by city by peak/non-peak period



3.4 Age group

Few passengers aged 18 were interviewed (following market research protocol) thus the survey age profile was older than the 'actual' user profile.

The age profiles were similar for the two questionnaires apart from one difference that was deliberately introduced though the distribution of fewer SP questionnaires to SuperGold Card users in the non-peak (the gold card allows free travel in the non-peak which was considered likely to bias the 'willingness-to-pay' response to the SP). Instead, SuperGold Card users were either handed a rating questionnaire or not surveyed at all. As a result of the questionnaire distribution, the rating and SP profiles were different for the over 64s with 9% completing rating questionnaires compared with 5% completing a SP questionnaire.

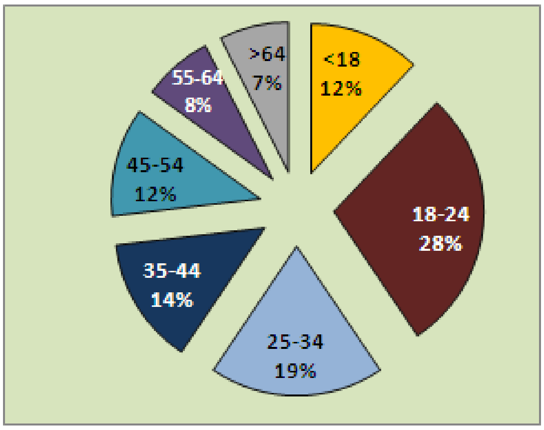
The average age of the passengers surveyed, calculated using the mid-point age for each category (15 for <18 age group) was 35.[5]

[5] Average age was calculated assuming mid-point ages of 15, 20, 30, 40, 50 and 70.

Table 3.5 Age group by survey

Age group	Number of responses			Percent of valid responses		
	Rating	SP	All	Rating	SP	All
<18	861	614	1,475	12%	12%	12%
18-24	1,877	1,602	3,479	27%	30%	28%
25-34	1,273	1,035	2,308	18%	20%	19%
35-44	964	713	1,677	14%	14%	14%
45-54	763	676	1,439	11%	13%	12%
55-64	572	356	928	8%	7%	8%
>64	626	285	911	9%	5%	7%
Av age	na	na	na	35	34	35
Valid responses	6,936	5,281	12,217	100%	100%	100%

Figure 3.5 Age group profile – all responses

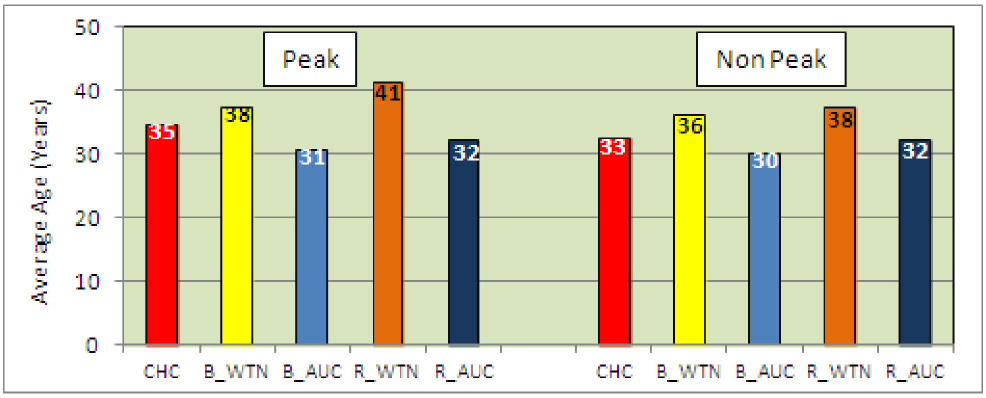


Peak respondents tended to be older than non-peak respondents with rail users tending to be older than bus users. The 'youngest' sample was Auckland bus with an average age of 30 and the oldest was Wellington rail where users averaged 41 years. Again, it should be noted that surveying outside term time may have increased the average age of Christchurch and Wellington respondents.

Table 3.6 Age group by city, mode and time period

Age group	Peak						Non-peak					
	Bus			Rail		All	Bus			Rail		All
	CHC	WTN	AUC	WTN	AUC		CHC	WTN	AUC	WTN	AUC	
<18	14%	5%	13%	4%	8%	7%	21%	11%	15%	14%	17%	15%
18-24	26%	23%	36%	12%	31%	23%	31%	28%	40%	23%	34%	32%
25-34	21%	22%	23%	19%	26%	21%	14%	18%	20%	14%	18%	17%
35-44	12%	19%	11%	24%	17%	19%	9%	12%	8%	14%	11%	11%
45-54	12%	15%	9%	23%	10%	16%	8%	11%	7%	14%	7%	9%
55-64	5%	9%	5%	15%	6%	10%	5%	8%	4%	10%	5%	6%
>64	10%	6%	3%	4%	2%	4%	11%	11%	7%	11%	9%	9%
Av age (years)	35	38	31	41	32	37	33	36	30	38	32	33
Valid response	226	825	1,111	1,856	589	4,607	1,093	1,592	2,461	1,533	931	7,610

Figure 3.6 Average age by mode and time period



Appendix B, tables B.3 and B.4 (see part 3 of this report) present the peak and non-peak profiles by aggregated route.

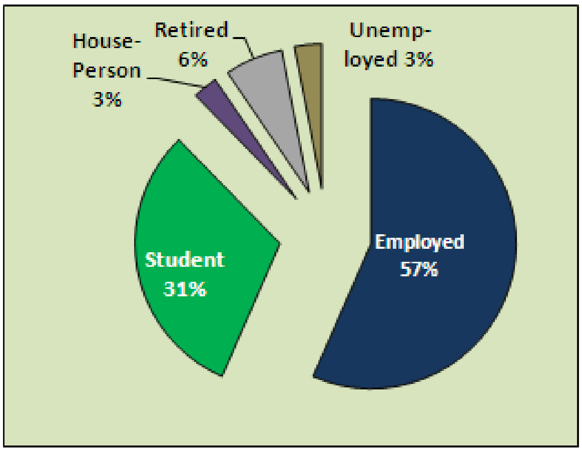
3.5 Socio-economic status

There was little difference in the socio-economic status of the two surveys with 57% employed and 31% students. There was a slightly lower percentage of retired people in the SP sample of 5% versus 8% in the rating survey (SuperGold Cards – see section 3.4). House persons and unemployed comprised a 3% share each of the sample.

Table 3.7 Socio-economic status by survey

Socio-economic status	Number of responses			Percent of valid responses		
	Rating	SP	All	Rating	SP	All
Employed	3,891	3,018	6,909	56%	57%	57%
Student	2,135	1,668	3,803	31%	32%	31%
House	174	166	340	3%	3%	3%
Retired	548	244	792	8%	5%	6%
Unemployed	177	194	371	3%	4%	3%
All	6,925	5,290	12,215	100%	100%	100%

Figure 3.7 Socio-economic status – all responses



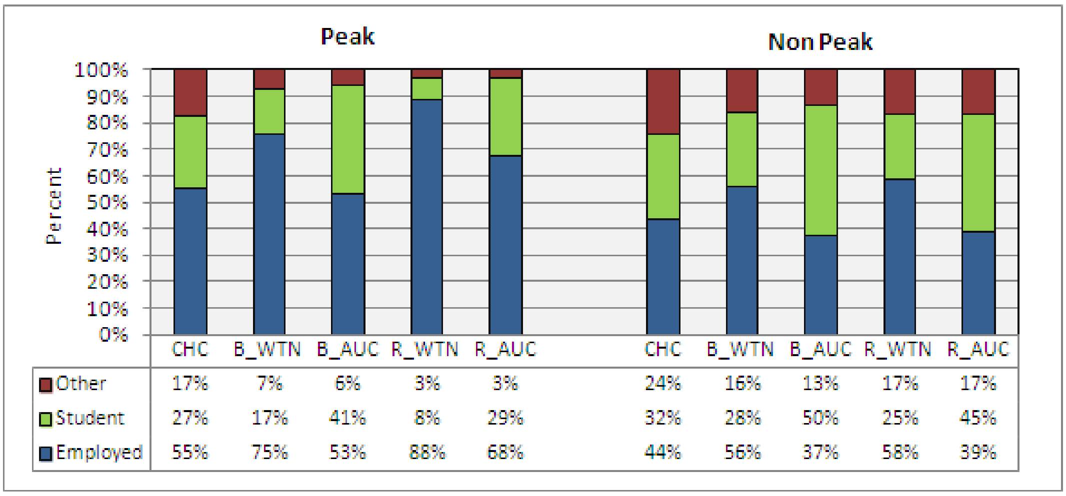
A higher percentage of Wellington respondents was employed. For the 'peak', 75% of Wellington bus and 88% of Wellington rail respondents were employed compared with 53% of Auckland bus and 68% of Auckland rail respondents and 55% of Christchurch bus respondents.

Table 3.8 Socio-economic status by city, mode and time period

Socio-economic status	Peak						Non-peak					
	Bus			Rail		All	Bus			Rail		All
	CHC	WTN	AUC	WTN	AUC		CHC	WTN	AUC	WTN	AUC	
Employed	55%	75%	53%	88%	68%	73%	44%	56%	37%	58%	39%	46%
Student	27%	17%	41%	8%	29%	21%	32%	28%	50%	25%	45%	37%
HousePerson	3%	2%	2%	1%	0%	1%	6%	3%	4%	2%	4%	4%
Retired	9%	4%	3%	2%	2%	3%	11%	10%	6%	10%	9%	9%
Unemployed	5%	2%	1%	1%	1%	1%	7%	3%	3%	4%	4%	4%
Valid response	229	828	1,120	1,860	588	4,625	1,094	1,582	2,457	1,531	926	7,590

Students made up a higher share of non-peak respondents. For Auckland, students comprised 50% of bus respondents and 45% of rail respondents. The student percentages were lower in Wellington and Christchurch (outside term time). In Wellington, 28% of bus and 25% of rail respondents were students in the non-peak and for Christchurch the student share was around a third.

Figure 3.8 Socio-economic status by city, mode and time period



Appendix B, tables B.5 and B.6 (see part 3 of this report) present the peak and non-peak profiles by aggregated route.

3.6 Occupation

Respondents who were employed were asked to describe their occupation. Ninety-seven percent of the occupation descriptions were categorised into nine occupation groups with the residual 3% coded as 'inadequately described'.

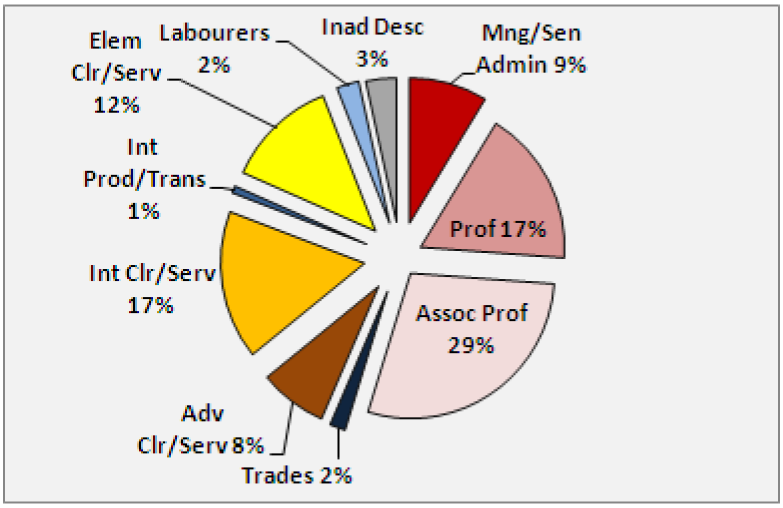
The response profile was similar for the rating and SP surveys.

Table 3.9 Occupation profile by survey

Occupation group	Number of responses			Percent of valid response		
	Rating	SP	All	Rating	SP	All
1. Managers/senior administrators	355	182	537	10%	7%	9%
2. Professional	586	490	1,076	17%	18%	17%
3. Associate professional	1,035	728	1,763	30%	27%	29%
4. Trades	57	50	107	2%	2%	2%
5. Advanced clerical/services	238	233	471	7%	9%	8%
6. Intermediate clerical/services	521	507	1,028	15%	19%	17%
7. Intermediate production/transport	24	25	49	1%	1%	1%
8. Elementary clerical/services	422	347	769	12%	13%	12%
9. Labourers	88	65	153	3%	2%	2%
10. Inadequately described	111	101	212	3%	4%	3%
Valid responses	3,437	2,728	6,165	100%	100%	100%
Employed respondents	3,891	3,018	6,909	na	na	na

Professional (17%) and associate professional (29%) were the most frequently stated occupations. Advanced (8%), intermediate (17%) and elementary clerical/service occupations (12%) accounted for 37% of the total employed. Relatively few 'blue collar' workers (5%) were surveyed, with trades accounting for 2%, intermediate production/transport workers 1% and labourers 2%.

Figure 3.9 Occupation profile – all responses



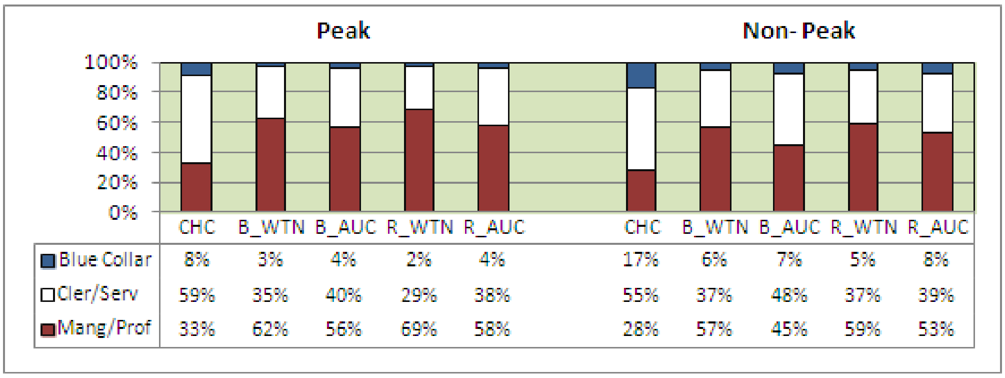
The Auckland and Wellington profiles were similar but Christchurch had a higher percentage of clerical and service workers. For Wellington, the highest peak percentage was associate professionals (accounting for 38% of employed rail passengers and 31% of employed bus passengers).

Table 3.10 Occupation profile by city, mode and time period

Occupation	Peak						Non-peak					
	Bus			Rail		All	Bus			Rail		All
	CHC	WTN	AUC	WTN	AUC		CHC	WTN	AUC	WTN	AUC	
1. Managers/senior administrators	4%	10%	6%	14%	9%	11%	1%	8%	4%	10%	9%	7%
2. Professional	17%	20%	19%	16%	21%	18%	10%	19%	17%	19%	17%	17%
3. Associate professional	11%	31%	30%	38%	26%	33%	13%	28%	21%	29%	25%	24%
4. Trades	5%	1%	1%	1%	2%	1%	5%	2%	1%	2%	3%	2%
5. Advanced clerical/services	9%	9%	7%	9%	7%	9%	6%	7%	6%	7%	6%	7%
6. Intermediate clerical/services	23%	15%	18%	14%	20%	16%	16%	16%	20%	17%	17%	17%
7. Intermediate production/transport	0%	0%	0%	0%	1%	0%	2%	1%	2%	1%	2%	1%
8. Elementary clerical/services	25%	11%	13%	5%	10%	9%	26%	13%	19%	12%	14%	16%
9. Labourers	3%	1%	3%	0%	2%	1%	9%	3%	4%	2%	3%	4%
10. Inadequately described	3%	2%	4%	1%	3%	2%	13%	3%	6%	2%	5%	5%
Valid responses	100	574	544	1,462	360	3,040	422	800	813	790	300	3,125
Employed respondents	127	625	591	1,645	397	3,385	479	882	910	894	359	3,524
Valid response – socio-economic status	229	828	1,120	1,860	588	4,625	1,094	1,582	2,457	1,531	926	7,590

Figure 3.10 presents a percentage histogram of occupations aggregated into three groups: managerial/professional (1–3), clerical/service (5, 6 and 8) and 'blue collar' (4, 7 and 9). 'Inadequately described' occupations were omitted so that the three groups sum to 100%.

Figure 3.10 Aggregated occupation profile by city, mode and time period



The highest percentage of managerial/professional occupations was on Wellington rail services with 69% of peak and 59% of non-peak passengers. Wellington bus and Auckland (bus and rail) were similar with managerial/professional shares of 56% to 62%. By contrast, the managerial/professional share was much lower in Christchurch at 33% peak and 28% non-peak with clerical/service occupations accounting for a higher share (59% of peak and 55% non-peak passengers).

Relatively few blue collar workers were surveyed. The highest percentage was 17% on non-peak Christchurch buses. For Wellington and Auckland, the percentage was around half that of Christchurch ranging from 2% to 8%.

Appendix B, table B.7 (see part 3 of this report) presents the occupation profile by route for the peak and non-peak periods although care should be taken with several of the route profiles given the small sample sizes.

The managerial/professional share was highest at 81% for Mairangi, Wrights Hill and Mt Victoria bus route during the peak. For rail, the highest managerial/professional share was on the Johnsonville line at 75%. For Auckland, the highest managerial/professional share was on peak Onehunga services (68%).

The highest blue collar share was 19% on South Manukau buses. For Wellington, the blue collar share was highest on the Hutt Valley (intra) bus route at 12% peak and 16% non-peak.

3.7 Personal income

An income question was included in the SP questionnaire but not on the rating question to enable the values of time to be analysed by income. The question asked respondents to indicate their annual income (before tax) from five income categories.

Figure 3.11 Income question in SP questionnaire

14. To help us analyse the data, could you indicate your annual personal income before tax?
1❐ Under $30,000 2❐ $30,000 to $59,999 3❐ $60,000 to $89,999 4❐ $90,000 to $119,999 5❐ Above $120,000

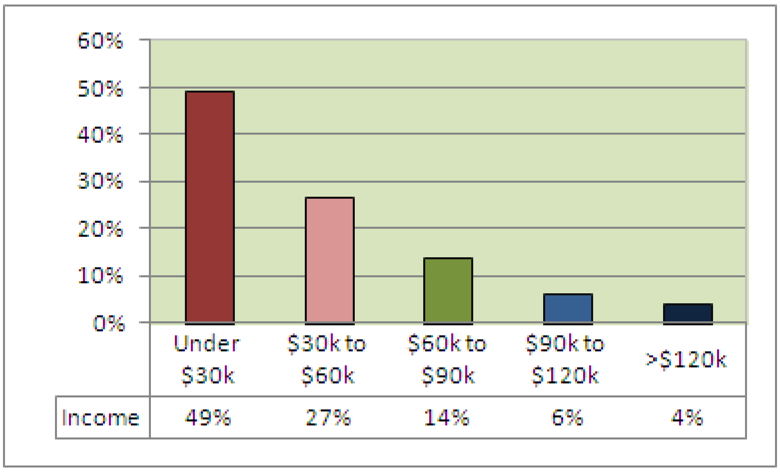
Around 8 out of 10 answered the question. The response profile is presented in table 3.11 and graphed in figure 3.12. Around one half (49%) of respondents had an income under $30,000. The percentage then reduced to 27% for the $30,000–$60,000 band, 14% for the $60,000–$90,000 band, 6% for the $90,000–$120,000 band and 4% for the over $120,000 band.

The average annual gross income was $42,000 (by taking the midpoint of each income band as given in the left-hand column of table 3.11 and multiplying it by the respective percentage and summing the product). The estimate is crude, however, (given the indeterminacy of the over $120,000 income bands for instance) but it did provide a useful indicator for the SP analysis.

Table 3.11 Annual gross personal income – SP survey response

Income band	Number	Percent
Under $30,000 (midpoint $15,000)	2,067	49%
$30,000 to $60,000 ($45,000)	1,119	27%
$60,000 to $90,000 ($75,000)	587	14%
$90,000 to $120,000 ($105,000)	258	6%
>$120,000 ($135,000)	179	4%
Valid response	4,210	100%
Non response	1,146	21%
Total response	5,356	100%
Annual gross average income	4,210	$42,000

Figure 3.12 Annual gross personal income – SP survey response



A probabilistic method was used to estimate incomes for respondents who did not answer the question. The approach was developed by Douglas Economics in a paper presented at the 36th Australasian Transport Research Forum by Douglas and Jones (2013). As well as infilling for non-response, the approach was used to estimate incomes for the rating survey (where the income question was not asked).

Income was cross tabulated against the employment/occupation questions. Then, for each respondent for whom the income was unknown, a random number was generated to 'look up' an income category using the cumulative percentage for each socio-economic/occupation category.

The cross-tabulation showed a strong relationship between income and the socio-economic status/ occupation category.

Just over 40% of managers/senior administrators (43%) were in the over $120,000 income band compared with 18% of professionals and 3% of associate professionals. Of the occupation categories, the percentage was either zero or negligible. Most were in the $30,000–$60,000 or under $30,000 income categories. Nearly all students (94%) and unemployed (90%) and 64% of retired respondents were in the under $30,000 category.

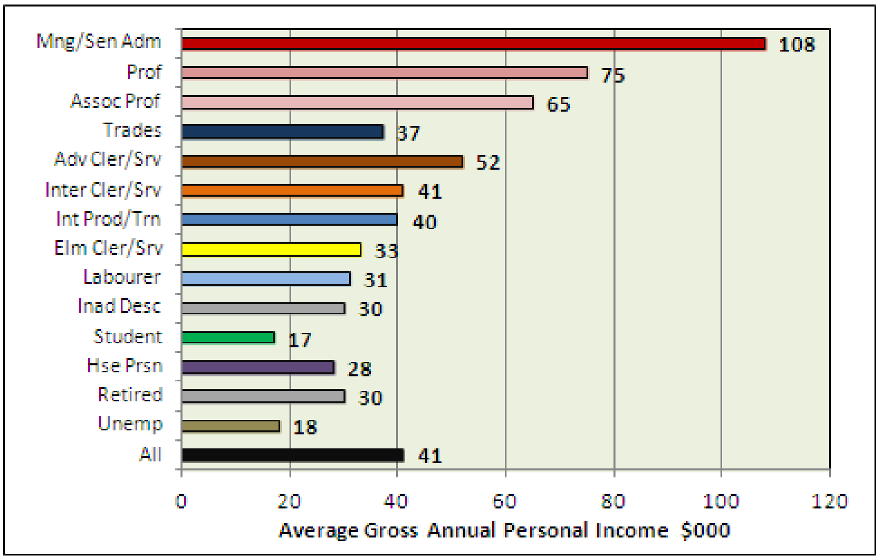
The average income ranged from $17,000 for students to $108,000 for managers/senior administrators. The overall average was $41,000 ($1,000 less than in table 3.11 due to a lower response).

Table 3.12 Income/socio-economic status and occupation cross tabulation

Occupation/economic status	Income category					Av income $000pa	Sample
	<$30,000	$30,000–$60,000	$60,000–$90,000	$90,000–$120,000	>$120,000		
1. Managers/senior administrators	0%	3%	29%	25%	43%	108	160
2. Professional	11%	27%	31%	14%	18%	75	422
3. Associate professional	11%	35%	33%	18%	3%	65	603
4. Trades	42%	44%	12%	2%	0%	37	43
5. Advance clerical/services	12%	58%	24%	6%	1%	52	198
6. Intermediate clerical/services	29%	59%	12%	1%	0%	41	434
7. Intermediate production/transport	32%	55%	14%	0%	0%	40	22
8. Elementary clerical/services	48%	47%	5%	1%	0%	33	302
9. Labourers	54%	38%	8%	0%	0%	31	52

Occupation/economic status	Income category					Av income $000pa	Sample
	<$30,000	$30,000–$60,000	$60,000–$90,000	$90,000–$120,000	>$120,000		
10. Inadequately described	66%	22%	9%	1%	1%	30	86
Student	94%	4%	1%	0%	0%	17	1,222
House person	72%	19%	6%	0%	3%	28	129
Retired	64%	25%	6%	5%	0%	30	173
Unemployed	90%	9%	1%	0%	0%	18	141
All	50%	26%	14%	6%	4%	41	3,987

Figure 3.13 Average annual gross personal income



Incomes were generated for all respondents who did not answer the question. Table 3.13 presents the 'in-filled' SP profile and the synthetic profile for the rating questionnaire. As can be seen, the income profiles for the two questionnaires were very close which simply reflected the strong correlation with the socio-economic/occupation profile.

Table 3.13 Estimated annual gross personal income profile

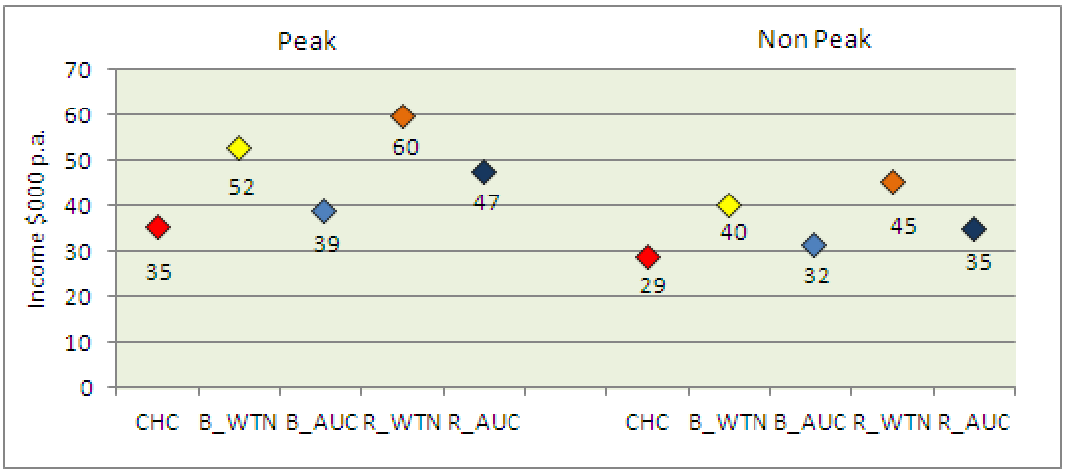
Income band	Number of responses			Percent of response		
	Rating	SP	All	Rating	SP	All
Under $30,000 (midpoint $15,000)	3,620	2,758	6,378	50%	51%	51%
$30,000 to $60,000 ($45,000)	1,776	1,366	3,142	25%	26%	25%
$60,000 to $90,000 ($75,000	1,015	682	1,697	14%	13%	14%
$90,000 to $120,000 ($105,000)	461	335	796	6%	6%	6%
>$120,000 ($135,000)	329	215	544	5%	4%	4%
Response	7,201	5,356	12,557	100%	100%	100%
Av gross annual income $	as above			42,000	41,000	42,000

Table 3.14 presents the estimated profile by city, mode and period with figure 3.14 graphing the mean estimates.

Table 3.14 Estimated annual gross personal income by city, mode and time period

Occupation	Peak						Non-peak					
	Bus			Rail		All	Bus			Rail		All
	CHC	WTN	AUC	WTN	AUC		CHC	WTN	AUC	WTN	AUC	
Under $30,000 ($1,000)	55%	34%	54%	23%	42%	37%	68%	53%	66%	46%	63%	37%
$3,000 to $60,000 ($45,000)	30%	32%	24%	32%	29%	30%	22%	24%	20%	26%	19%	30%
$60,000 to $90,000 ($75,000	9%	17%	13%	24%	16%	18%	7%	14%	8%	15%	11%	18%
$90,000 to $120,000 ($105,000)	4%	9%	5%	13%	8%	9%	2%	6%	3%	8%	4%	9%
>$120,000 ($135,000)	2%	8%	3%	8%	6%	6%	1%	4%	2%	5%	3%	6%
Average income $000	35	52	39	60	47	51	29	40	32	45	35	36
Std deviation	28	37	32	36	36	36	24	33	28	36	31	31
Std error	1.8	1.3	1.0	0.8	1.5	0.5	0.7	0.8	0.6	0.9	1.0	0.4
Response	237	837	1,139	1,869	604	4,686	1,148	1,643	2,560	1,552	968	7,871

Figure 3.14 Estimated annual gross personal income by city, mode and time period

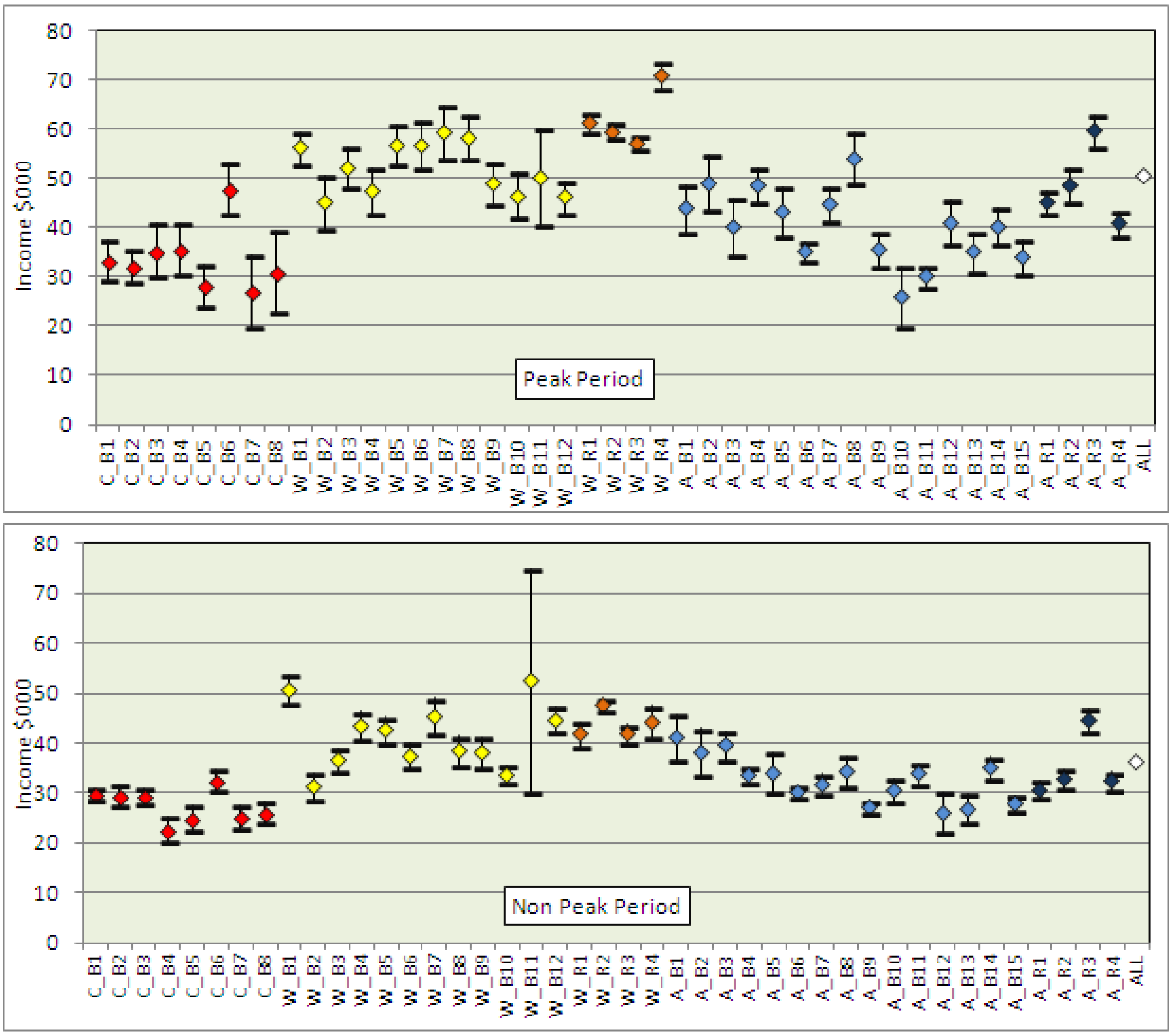


Average incomes were a quarter to a third higher in the peak. Wellington rail users tended to have the highest incomes, averaging $60,000 in the peak and $45,000 in the non-peak. Wellington bus users were second with average peak incomes of $52,000 and and non-peak incomes of $40,000. Christchurch bus users had the lowest incomes averaging $35,000 in the peak and $29,000 in the non-peak. Auckland rail users had higher incomes than bus users: for the peak, the average rail user income was $47,000 compared with $39,000 for bus users; whereas for the non-peak, the gap was less at $35,000 versus $32,000.

Given the large sample sizes, the standard error of the estimates was narrow. The largest was for peak Christchurch users at ±$1,800 (5% of the mean estimate). It should be stressed, however, that the standard error is indicative only (being reduced by the categorical nature of the estimates). Figure 3.15 graphs the mean income ± standard error.[6] Appendix B, table B.8 (see part 3 of this report) gives the estimates by aggregated route.

[6] Standard error is the standard deviation divided by the square root of the sample size.

Figure 3.15 Estimated annual gross personal income by aggregated bus and rail route



The three highest average incomes were all on peak rail services with Wairarapa (W_R4) top at $71,000, Johnsonville (W_R1) second at $61,000 and Onehunga (A_R3) third at $60,000.

The two highest peak income bus routes were the Wellington Kingston, Kowhai Park and Aro Valley route (W_B7) at $59,000 and the Eastbourne/Wainui (B_W8) route which averaged $58,000. Average incomes on Auckland bus routes were lower reflecting higher student volumes with the highest average income of $54,000 on the SW bus routes 258–287 (A_B8). Christchurch average incomes were lower with the highest of $48,000 on the Airport – Sumner (C_B6) route.

Non-peak incomes were lower than in the peak reflecting a lower proportion of employed passengers. The lowest were in Christchurch with West-South East (C_4) at the bottom with an average of $23,000. The highest average income was on the Newtown, Island Bay and Happy Valley bus route at $51,000.[7]

[7] Ignoring the Paraparaumu service with only four non-peak responses.

3.8 Frequency of use

A question on the frequency of use of public transport was included on the rating questionnaire to test whether the views of regular users had different opinions from occasional users for such attributes as *information* and *space for belongings*.

Figure 3.16 Wellington bus rating questionnaire

10. How often do you travel by bus?

1❐ 4 or more days a week 2❐ 1-3 days a week 3❐ 1-3 days a month
4❐ 2-11 days a year 5❐ Once a year or less 6❐ First time

Three-quarters of Auckland and Wellington rail respondents used public transport daily. By comparison, peak Wellington and Christchurch bus respondents tended to be less frequent users with two thirds of Wellington and one half of Christchurch respondents using bus services each weekday.

Table 3.15 Frequency of use of bus and rail services by city, mode and time period

Usage	Peak						Non-peak						All
	Bus			Rail		All	Bus			Rail		All	
	CHC	WTN	AUC	WTN	AUC		CHC	WTN	AUC	WTN	Auc		
>= 4 days/wk	54%	66%	78%	77%	73%	74%	54%	53%	64%	43%	39%	51%	60%
1-3 days/wk	34%	24%	16%	13%	12%	15%	30%	28%	21%	22%	15%	23%	20%
1-3 days/month	7%	5%	3%	5%	7%	5%	9%	10%	7%	15%	18%	12%	9%
2-11 days/ year	0%	3%	2%	4%	6%	4%	4%	5%	3%	12%	17%	8%	7%
<= once a year	0%	1%	0%	1%	1%	1%	1%	2%	2%	4%	7%	3%	2%
First time	5%	2%	1%	1%	2%	1%	2%	2%	3%	4%	4%	3%	2%
Response	61	349	512	1,304	399	2,625	443	804	1,129	992	768	4,136	6,761

Respondents, who used services at least once a week were classed as 'frequent' accounting for 80% of peak users (see figure 3.17). Rail passengers travelling in the non-peak tended to be less frequent with 54% of Auckland and 64% of Wellington respondents using rail once a week or more.

Figure 3.17 Frequency of use of bus and rail services by city, mode and time period

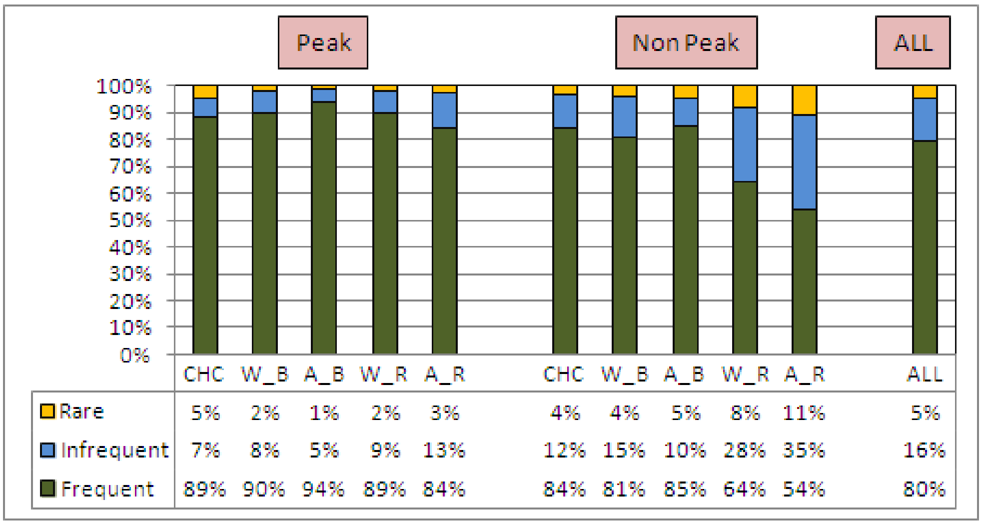
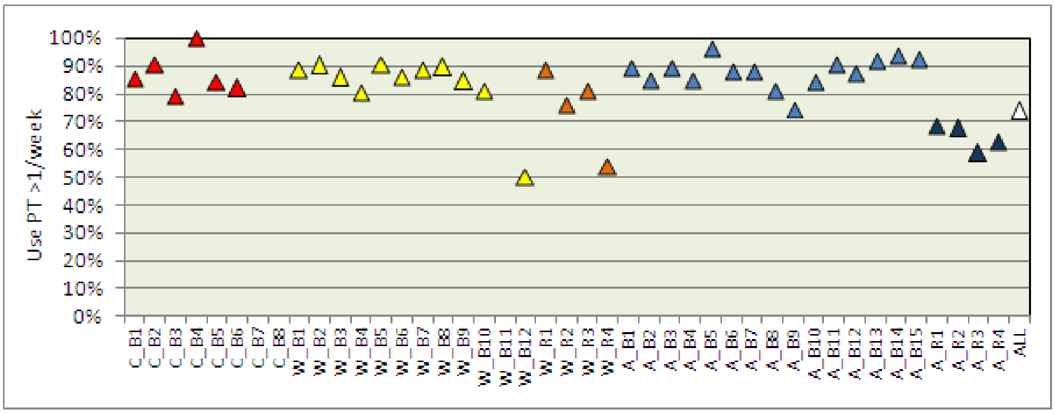


Figure 3.18 plots the percentage using bus (or rail) more than once a week. Peak and non-peak responses were combined due to the small sample sizes for some routes. Some routes are not shown because the samples were too small. Most routes were sampled sufficiently, however, and the graph shows a similar profile apart from three exceptions.

Auckland rail was one exception with the share of frequent users falling below 70%. In Wellington, only around one half of the Airport Express respondents were frequent users. The Wairarapa line also had a lower percentage of frequent users at 54%.

Appendix B, table B.9 (see part 3 of this report) provides more detailed figures.

Figure 3.18 Frequency of use of bus and rail services by aggregated route



4 Travel time and fare

4.1 Introduction

The survey asked about three elements of travel time. First, respondents were asked how long they spent onboard the bus or train. Second, respondents were asked how about the frequency of their service and third how long they had waited for their bus or train. Each of the three components is discussed in turn. Then, in section 4.5, the relationship between frequency and service interval is described.

A main aim of the study was to evaluate passengers' willingness to pay for service improvements. Ascertaining the fare passengers pay per trip is a first step in gauging the willingness to pay more for quality improvements. Accordingly, the rating and SP surveys asked passengers their type of ticket and the SP survey then asked respondents to estimate the cost of the trip they were making. Sections 4.6 and 4.7 look at these aspects in turn. Finally, in section 4.8 the relationship between fare and in vehicle time is investigated and shows the relationship to be close to a straight line.

4.2 Onboard travel time

The willingness to pay for vehicle quality was considered likely to be related to the time spent on the bus or train. Accordingly, the SP questionnaires were 'tailored' to trip length. To hand out the appropriate questionnaire, surveyors first asked people how long they would be on the bus/train.

As well as the 'pre question' asked in the SP survey, both the SP and the rating questionnaire asked respondents to estimate the time they would spend on onboard the bus or train service. Clearly, the times given were 'perceived' rather than actual.[8]

There was virtually no difference in the response profiles for the two surveys. The average time using the response to both surveys was 26.5 minutes. The median time was 20 minutes.

Respondents tended to round their estimates to the nearest five minutes as can be seen from figure 4.1 which graphs the travel times. The most frequent cited time was 20 minutes (19%) followed by 10 minutes (17%) then 15 minutes (12%) and 30 minutes (11%).

Some surveyors noted a reluctance of some passengers making short trips to fill in a questionnaire. However 484 (4%) passengers were making trips of five minutes, which provided sufficient response size to assess whether short trips were different from longer trips.

There was a 'long tail' to the distribution with 1,009 making trips of over 50 minutes. The longest time was three hours which was given by two Wairarapa line users.[9]

The average travel times were similar for bus respondents in Wellington and Christchurch at 20–24 minutes, see figure 4.3 and table 4.2. Auckland bus travel times were five minutes longer averaging 27 minutes in the peak and 25 minutes in the non-peak.

[8] The data presents the opportunity for future work to compare the perceived times with the actual times in the timetable. This comparison would be easiest for rail.

[9] Given that Masterton – Wellington takes 1½ hours, either the passengers must have been including access and egress time.

Rail trips were longer averaging 30 minutes on Wellington peak and 34 minutes on non-peak services. For Auckland, the average times were 32 minutes and 28 minutes respectively.

Table 4.1 Onboard travel time by survey

In-vehicle time range	Number of responses			Percent of valid responses		
	Rating	SP	All	Rating	SP	All
2-9 mins	439	329	768	7%	7%	7%
10-14 mins	808	650	1,458	13%	13%	13%
15 mins	801	616	1,417	12%	12%	12%
16-19 mins	159	106	265	2%	2%	2%
20 mins	1,253	932	2,185	19%	19%	19%
21-25 mins	589	437	1,026	9%	9%	9%
26-30 mins	758	597	1,355	12%	12%	12%
31-39 mins	211	180	391	3%	4%	3%
40-50 mins	899	680	1,579	14%	14%	14%
51-180 mins	516	493	1,009	8%	10%	9%
Valid responses	6,433	5,020	11,453	100%	100%	100%
Average (mins)	"	"	"	26.3	26.9	26.5
Std dev (mins)	"	"	"	16.9	16.9	16.9
Median (mins)	"	"	"	20	20	20

Figure 4.1 Onboard travel time – response profile

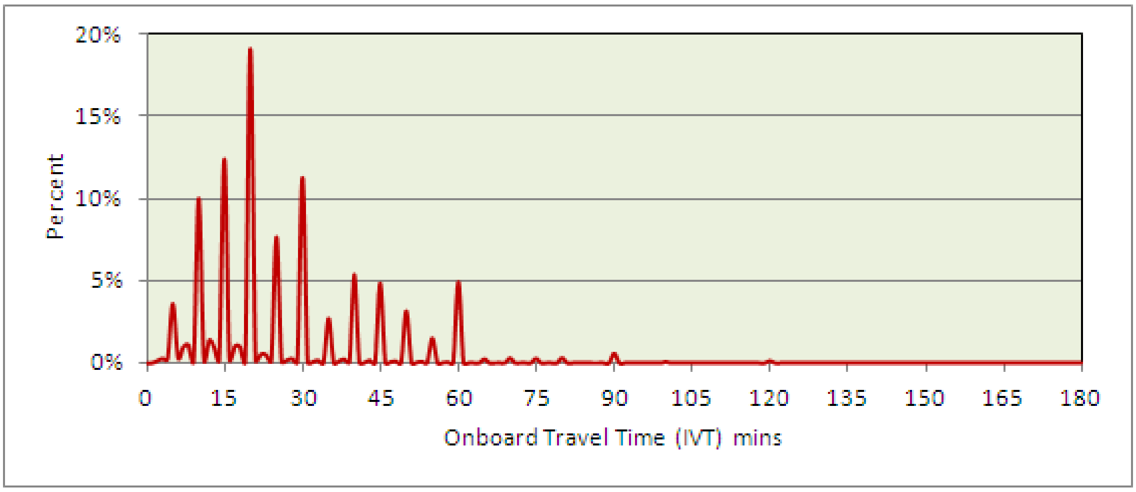


Figure 4.2 Onboard travel time – cumulative response profile

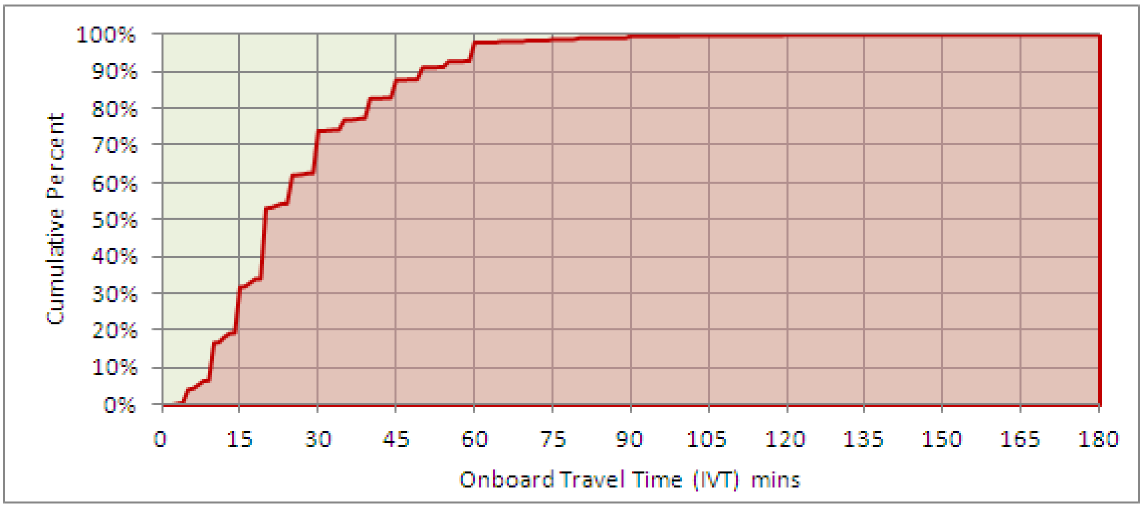


Figure 4.3 Onboard travel time by city, mode and time period

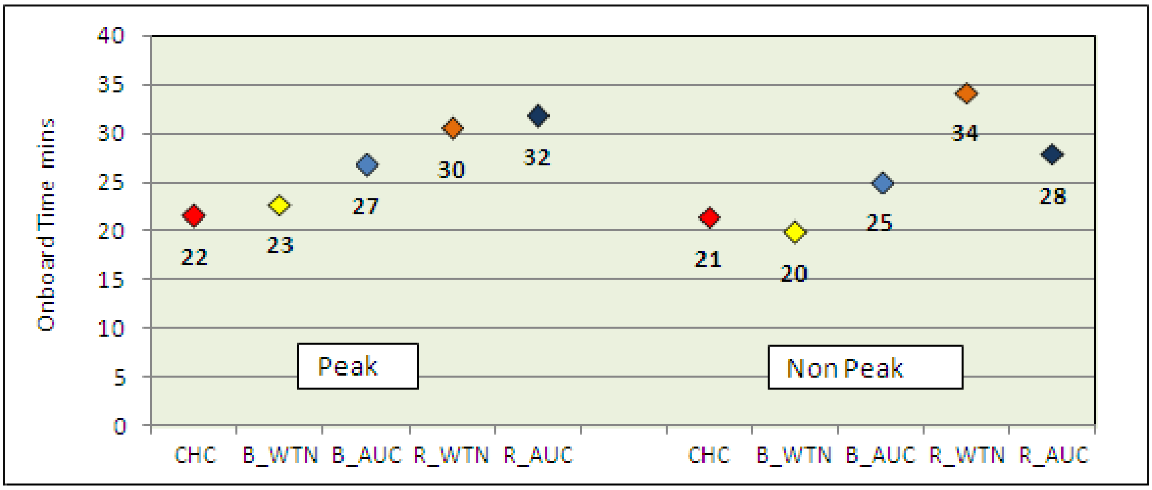


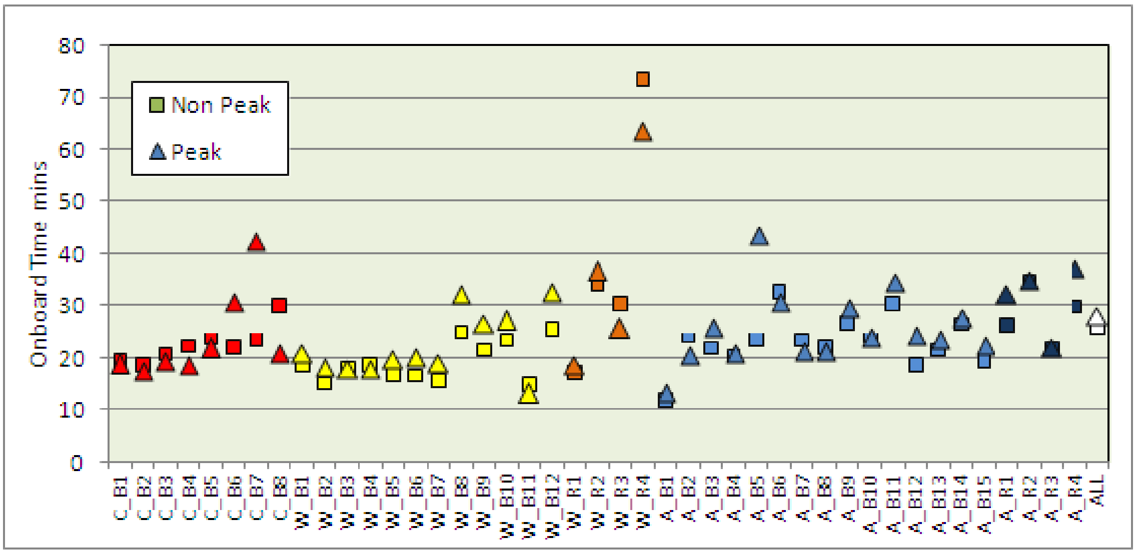
Table 4.2 Onboard travel time by city, mode and time period

In-vehicle time range	Peak						Non-peak					
	Bus			Rail		All	Bus			Rail		All
	CHC	WTN	AUC	WTN	AUC		CHC	WTN	AUC	WTN	AUC	
2–9 mins	9%	7%	7%	2%	2%	4%	10%	11%	9%	4%	6%	8%
10–14 mins	24%	15%	12%	8%	5%	11%	19%	17%	15%	8%	10%	14%
15 mins	11%	14%	14%	11%	8%	12%	14%	17%	13%	9%	11%	13%
16–19 mins	1%	2%	2%	4%	2%	3%	2%	2%	2%	3%	3%	2%
20 mins	16%	21%	18%	23%	13%	20%	21%	22%	18%	17%	15%	19%
21–25 mins	7%	12%	8%	13%	11%	11%	7%	9%	7%	9%	8%	8%
26–30 mins	17%	15%	12%	7%	14%	11%	12%	13%	12%	10%	17%	12%
31–39 mins	7%	4%	4%	4%	8%	4%	3%	3%	3%	3%	3%	3%
40–50 mins	4%	10%	15%	15%	28%	15%	9%	6%	14%	15%	21%	13%

In-vehicle time range	Peak						Non-peak					
	Bus			Rail		All	Bus			Rail		All
	CHC	WTN	AUC	WTN	AUC		CHC	WTN	AUC	WTN	AUC	
51-180 mins	4%	2%	9%	14%	8%	10%	3%	1%	7%	23%	6%	8%
Valid response	214	756	1,070	1,739	562	4,341	990	1,515	2,337	1,453	817	7,112
Average (mins)	22	23	27	30	32	28	21	20	25	34	28	26
Std dev (mins)	13.5	12.6	17	18.4	14.5	16.8	13.3	10.9	16	21.7	15.3	16.8
Median (mins)	20	20	20	24	30	22	20	20	20	30	20	20

Appendix B, table B.10 (see part 3 of this report) presents onboard times by aggregated route by time period. Figure 4.4 presents the times by route for the peak and non-peak periods. The 'outlier' was the Wairarapa line where the average onboard time was much longer at over an hour.

Figure 4.4 Onboard travel time by route and period



Two thirds of peak bus times were higher (triangles) than the respective non-peak (squares) time which may reflect road congestion. On average, the peak time was 10% higher than the non-peak time.[10] By contrast, there was no noticeable difference in the peak and non-peak times for rail.

There were two bus routes where the times were short averaging 15 minutes: Paraparaumu (W_B11) and Auckland city link and inner loop (A_B1).

Two bus routes had times of over 40 minutes: Christchurch outer west/south west (C_B7) and Auckland central south (A_B5).

[10] The average percentage increase: $\frac{1}{22}\sum_{22}\frac{IVTpk_i}{IVTnonpk_i}$

4.3 Service interval

Respondents were asked how frequent was their service when they were surveyed. As with onboard time, the survey provided the 'perceived' frequency rather than the 'actual' frequency.[11]

The term 'service interval' is used rather than 'frequency'. Service interval is the number of minutes between departures.

Table 4.3 presents the aggregated service interval response. Response was lower for the rating survey because the question was not asked on the 'inbound' rail questionnaire. There was little difference in the response profiles for the two surveys. The average service interval was 24 minutes with a median of 20 minutes; the distribution being skewed to the right by some long service intervals given by Wairarapa line respondents.

Table 4.3 Service interval by survey

Service interval	Number of responses			Percent of valid responses		
	Rating	SP	All	Rating	SP	All
<8 mins	206	192	398	5%	4%	5%
8–12 mins	587	541	1,128	14%	12%	13%
13–17 mins	927	1,151	2,078	22%	25%	24%
18–22 mins	548	652	1,200	13%	14%	14%
23–27 mins	106	109	215	3%	2%	2%
28–32 mins	1,286	1,575	2,861	31%	34%	33%
33–37 mins	21	39	60	1%	1%	1%
38–42 mins	61	64	125	1%	1%	1%
43–47 mins	54	55	109	1%	1%	1%
48–52 mins	14	13	27	0%	0%	0%
53–57 mins	2	6	8	0%	0%	0%
58–62 mins	298	229	527	7%	5%	6%
>63 mins	28	14	42	1%	0%	0%
Valid responses	4,138	4,640	8,778	100%	100%	100%
Average (mins)	"	"	"	25	23	24
Std dev (mins)	"	"	"	24	13	19
Median (mins)	"	"	"	20	20	20

As can be seen in figure 4.5, services every 30 minutes were the most often given with just under one third of respondents giving this service interval. Just over a fifth gave a 15-minute frequency; 13% every 20 minutes and 11% every 10 minutes. Six percent gave an hourly frequency. At the other end of the frequency spectrum, 3% gave a five-minute frequency.

The cumulative frequency graph in figure 4.6 shows that only 10% of respondents were using a service that had a frequency less than half-hourly.

[11] The data provides the opportunity to compare the perceived and actual frequencies (as given in the timetable).

Figure 4.5 Service interval – response profile

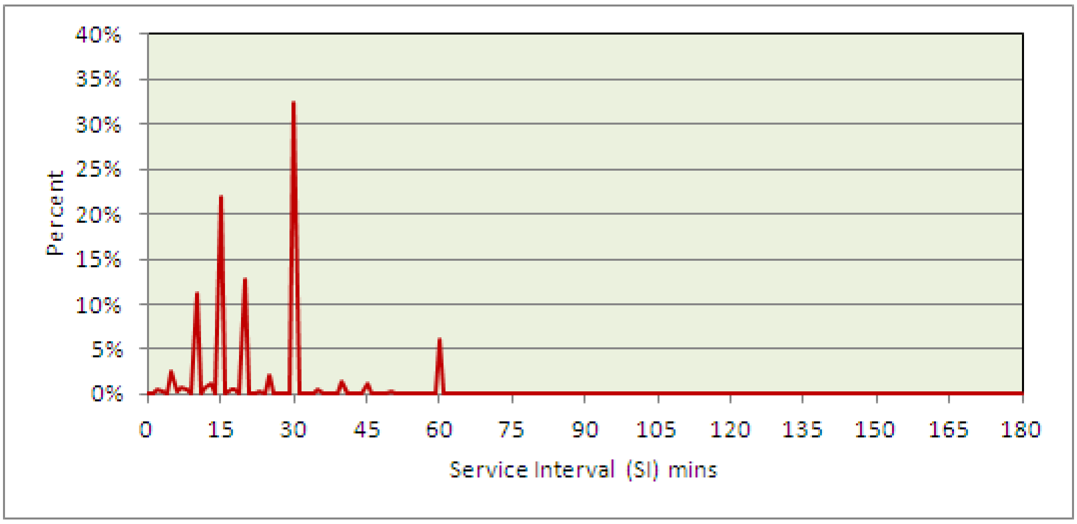
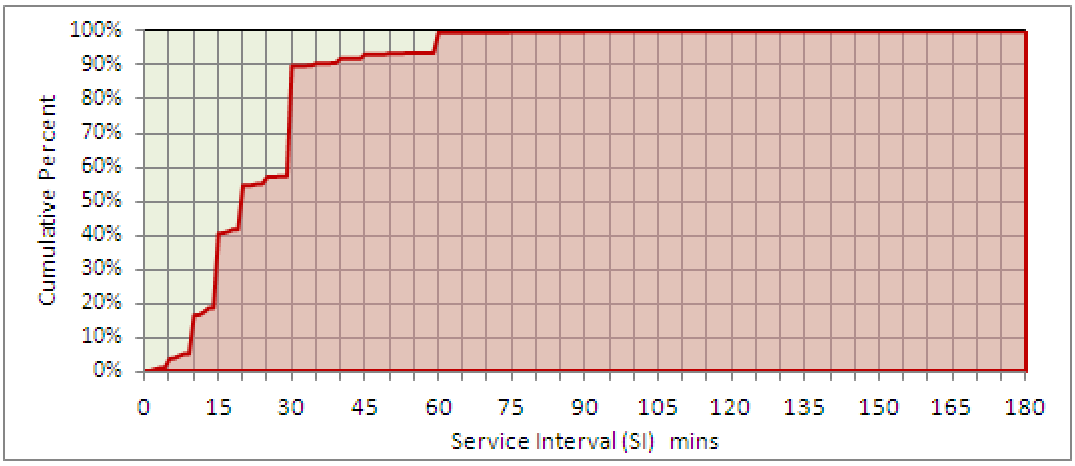


Figure 4.6 Service interval – cumulative response profile



As would be expected, the service interval tended to be lower in the peak than in the non-peak. Table 4.4 and figure 4.7 present the estimates.

The estimates were affected by sampling. In Christchurch, the large number of questionnaires completed on the Orbiter service reduced the average service interval in the non-peak.

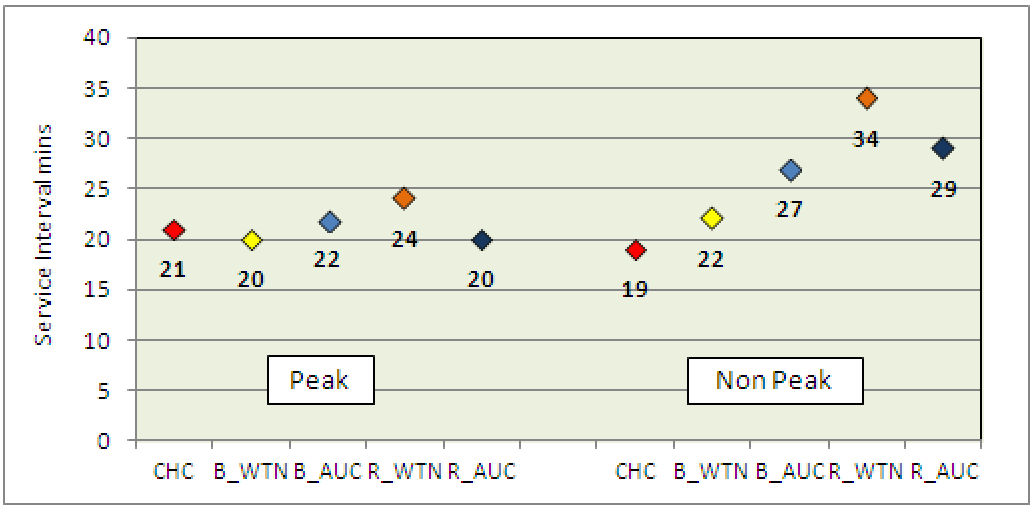
For Wellington, the peak service interval for buses was 20 minutes and 24 minutes for rail. In the non-peak, the estimates were 22 minutes and 34 minutes respectively. It should be noted that the inclusion of the Wairarapa service (there is only one in the non-peak) inflated the non-peak service interval for rail.

For Auckland, the train service interval was lower at 20 minutes in the peak than the bus service interval at 22 minutes. In the non-peak, the bus service interval increased to 27 minutes and the rail service interval to 29 minutes.

Table 4.4 Service interval by city, mode and time period

Service interval range	Peak						Non-peak					
	Bus			Rail		All	Bus			Rail		All
	CHC	WTN	AUC	WTN	AUC		CHC	WTN	AUC	WTN	Auc	
<8 mins	3%	10%	9%	1%	6%	6%	2%	6%	4%	2%	6%	4%
8-12 mins	15%	17%	18%	5%	13%	13%	22%	15%	11%	6%	12%	13%
13-17 mins	32%	31%	24%	16%	36%	25%	41%	30%	18%	19%	32%	23%
18-22 mins	12%	14%	14%	29%	18%	19%	9%	9%	12%	33%	16%	11%
23-27 mins	3%	2%	1%	7%	2%	3%	2%	1%	2%	8%	2%	2%
28-32 mins	32%	20%	22%	38%	20%	27%	22%	33%	32%	44%	18%	36%
33-37 mins	1%	0%	1%	0%	0%	1%	0%	1%	1%	0%	0%	1%
38-42 mins	1%	1%	2%	1%	1%	1%	1%	1%	3%	2%	1%	1%
43-47 mins	1%	1%	1%	1%	2%	1%	0%	1%	2%	1%	1%	1%
48-52 mins	1%	0%	1%	0%	0%	0%	0%	0%	1%	0%	0%	0%
53-57 mins	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%
58-62 mins	2%	4%	7%	1%	3%	4%	1%	4%	12%	1%	3%	7%
>63 mins	1%	0%	0%	0%	0%	0%	0%	0%	1%	0%	0%	1%
Valid response	199	700	1,006	935	307	3,147	980	1,360	2,129	820	342	5,631
Average (mins)	21	20	22	24	20	22	19	22	27	34	29	25
Std dev (mins)	11	12	15	9	11	12	9	13	16	44	18	22
Median (mins)	18	15	17	20	15	20	15	17	30	30	25	20

Figure 4.7 Service interval by city, mode and time period

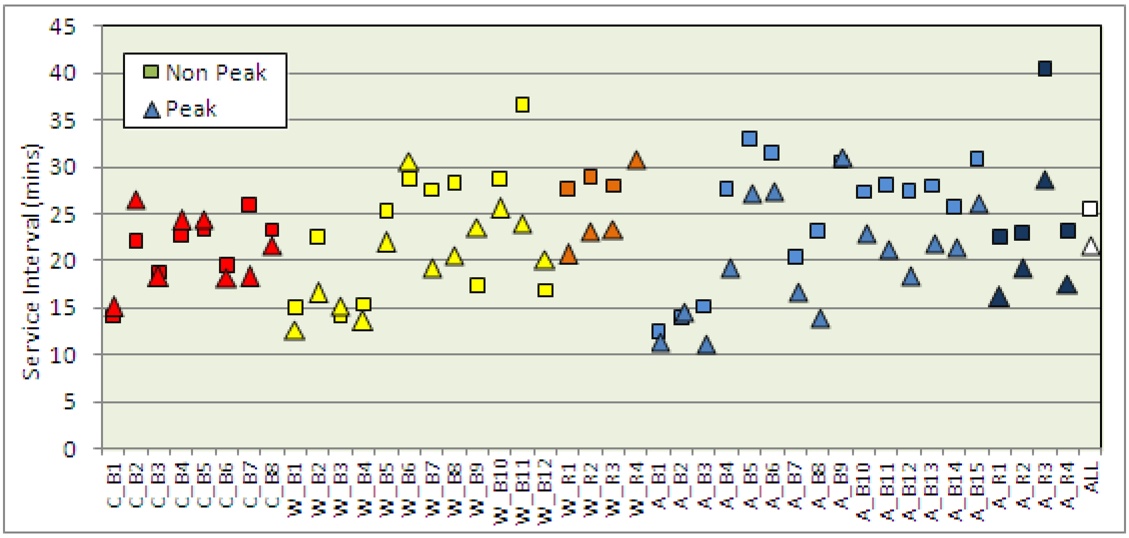


Appendix B, table B.11 (see part 3 of this report) presents service interval by route. Figure 4.8 presents the average times by route for the peak and non-peak. Omitted from the graph is the perceived off-peak service interval for the Wairarapa line (214 minutes).

As would be expected, the non-peak service interval tended to be longer than for the peak and this was the case for three-quarters of the routes. Over the 43 routes, the peak service interval averaged 15% less than in the non-peak. However for 10 routes, five of them in Christchurch, the peak service interval was longer than in the non-peak.

Excluding the Wairarapa rail line, the lowest frequency service was the Onehunga rail line (A_R3) with a 41-minute service interval. The most frequent services were the peak period Auckland City Link/Inner Loop (A_B1) and the Northern Express (A_B3) bus services with perceived frequencies of just over 10 minutes.

Figure 4.8 Service interval by route and period



4.4 Wait time

Respondents were asked how long they had waited for their bus or train. The question had a dual purpose. First, there was an expectation that the willingness to pay for stop/station quality would be related to the time spent at the stop/station. Second, in conjunction with the service interval, the survey provided the basis to predict wait time based on service interval. Section 4.5 models this relationship.

Table 4.5 shows a lower wait time for the SP survey of 8.2 minutes than for the rating survey (9.6 minutes). The combined average was 8.9 minutes. As with the service interval, the distribution was skewed to the right by a few long waits. The median wait time was five minutes for the SP survey and seven minutes for the rating survey.

Table 4.5 Wait time by survey

Wait time	Number of responses			Percent of valid responses		
	Rating	SP	All	Rating	SP	All
< 8mins	2,456	3,085	5,541	52%	59%	56%
8–12 mins	1,134	1,153	2,287	24%	22%	23%
13–17 mins	429	415	844	9%	8%	9%
18–22 mins	316	287	603	7%	5%	6%
23–27 mins	81	63	144	2%	1%	1%
28–32 mins	170	142	312	4%	3%	3%
33–37 mins	20	10	30	0%	0%	0%
38–42 mins	31	20	51	1%	0%	1%

Wait time	Number of responses			Percent of valid responses		
	Rating	SP	All	Rating	SP	All
43-47 mins	16	15	31	0%	0%	0%
48-52 mins	7	6	13	0%	0%	0%
53-57 mins	2	1	3	0%	0%	0%
58-62 mins	23	21	44	0%	0%	0%
>63 mins	6	5	11	0%	0%	0%
Valid responses	4,691	5,223	9,914	100%	100%	100%
Average (mins)	-	-	-	9.6	8.2	8.9
Std dev (mins)	-	-	-	10	8.6	9.2
Median (mins)	-	-	-	7	5	5

Figure 4.9 shows 7% of respondents gave a zero wait time implying they arrived at the bus stop or train station exactly when the bus or train arrived. As with onboard time and service interval, respondents tended to round their wait time to the nearest five minutes: 21% gave a wait time of five minutes, 19% 10 minutes, 7% 15 minutes, 6% 20 minutes and 3% 30 minutes.

The cumulative frequency graph in figure 4.10 shows that 50% waited for five minutes or less and three quarters waited for 10 minutes or less.

Figure 4.9 Wait time – response profile

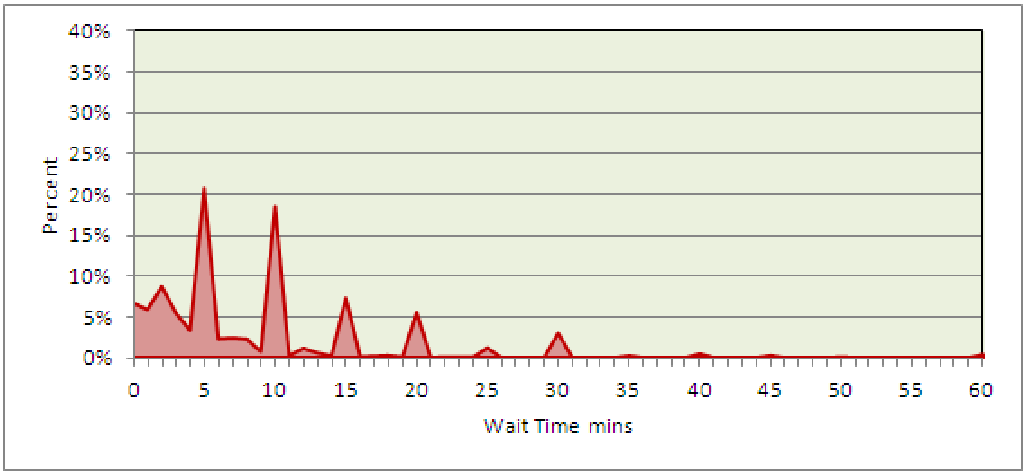
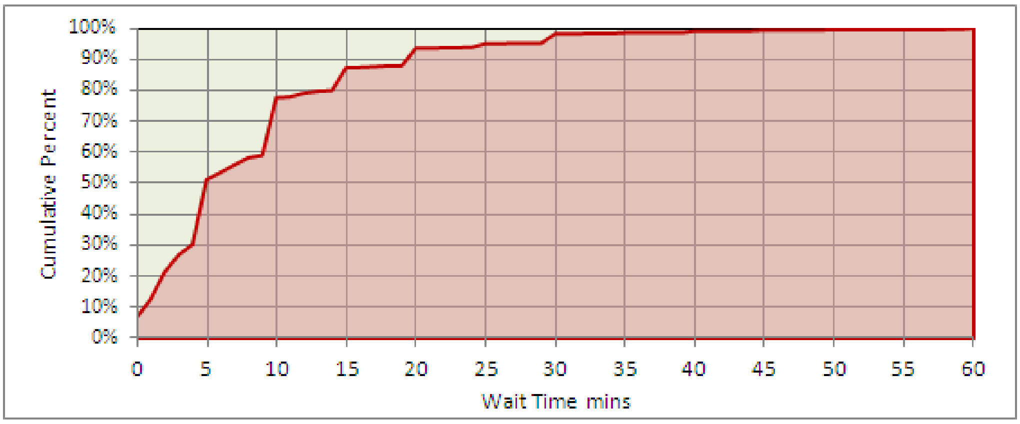


Figure 4.10 Wait time – cumulative response

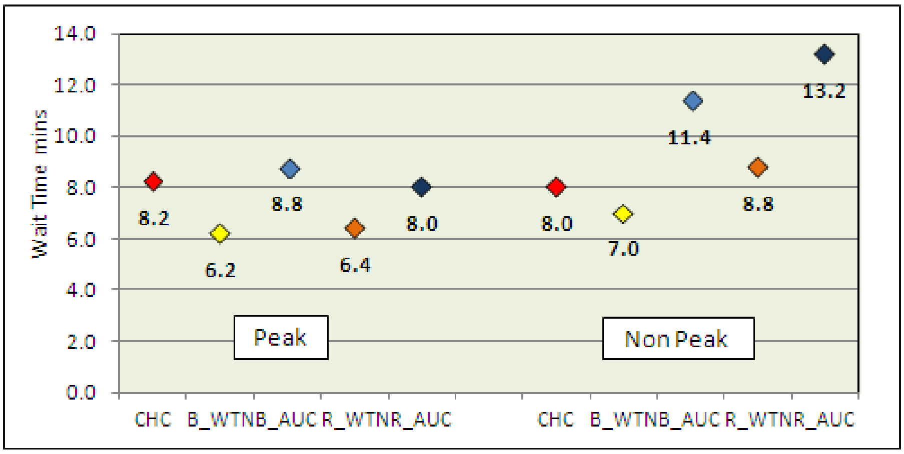


Wait times tended to be lower in the peak than in the non-peak reflecting a lower service frequency. Table 4.6 and figure 4.11 present the estimates.

Table 4.6 Wait time by city, mode and time period

Wait time	Peak						Non-peak					
	Bus			Rail		All	Bus			Rail		All
	CHC	WTN	AUC	WTN	AUC		CHC	WTN	AUC	WTN	Auc	
<8 mins	56%	72%	54%	67%	58%	62%	57%	65%	44%	56%	36%	53%
8–12 mins	29%	18%	25%	0%	1%	22%	24%	21%	24%	22%	30%	24%
13–17 mins	5%	6%	10%	1%	2%	8%	9%	6%	11%	9%	9%	9%
18–22 mins	5%	3%	6%	0%	0%	4%	6%	4%	10%	7%	8%	7%
23–27 mins	1%	0%	1%	0%	0%	1%	1%	2%	2%	2%	2%	2%
28–32 mins	4%	1%	3%	0%	0%	2%	2%	2%	5%	3%	9%	4%
>33 mins	0%	0%	2%	32%	37%	1%	1%	0%	4%	1%	1%	0%
Valid responses	227	783	1,108	964	337	3,419	1,107	1,585	2,460	902	439	6,493
Average (mins)	8.2	6.2	8.8	6.4	8.0	7.4	8.0	7.0	11.4	8.8	13.2	9.5
Std dev (mins)	7.5	5.8	8.5	5.3	7.5	7.1	7	6.7	10.7	8.0	11.6	9.2
Median (mins)	6	5	6	5	5	5	6	5	10	5	10	6

Figure 4.11 Wait time by city, mode and time period



The shortest waits were for Wellington buses which averaged 6.2 minutes in the peak and 7 minutes in the non-peak. Waits for Wellington trains averaged 6.4 minutes in the peak and 8.8 minutes in the non-peak.

Christchurch waits averaged 8.2 minutes in the peak and eight minutes in the non-peak.

Auckland bus respondents tended to wait longer averaging 8 minutes in the peak and 11.4 minutes in the non-peak. For Auckland rail, the average wait was 8 minutes in the peak and 13.2 minutes in the non-peak.

Appendix B, table B.12 (see part 3 of this report) presents the average wait time by aggregated route by time period. Figure 4.12 presents the average times for the peak and non-peak. Of the 43 aggregated routes, 31 (72%) had a lower wait time in the non-peak. Of the 12 exceptions, six were in Wellington, four in Christchurch and two in Auckland. As with onboard time and service interval, sampling differences (and for some routes small sample sizes) between the two periods probably contributed to the lower non-peak waiting times although higher traffic may tend to bunch bus services in the peak, thereby lengthening wait times.

The longest wait was 15.2 minutes for the 'Far North' (C-B8) Christchurch bus service (sample size 15) in the peak. In the non-peak, the average wait was lower at 10.5 minutes.

Also around 15 minutes, both in the peak and non-peak, was the Auckland South (300s) bus service.

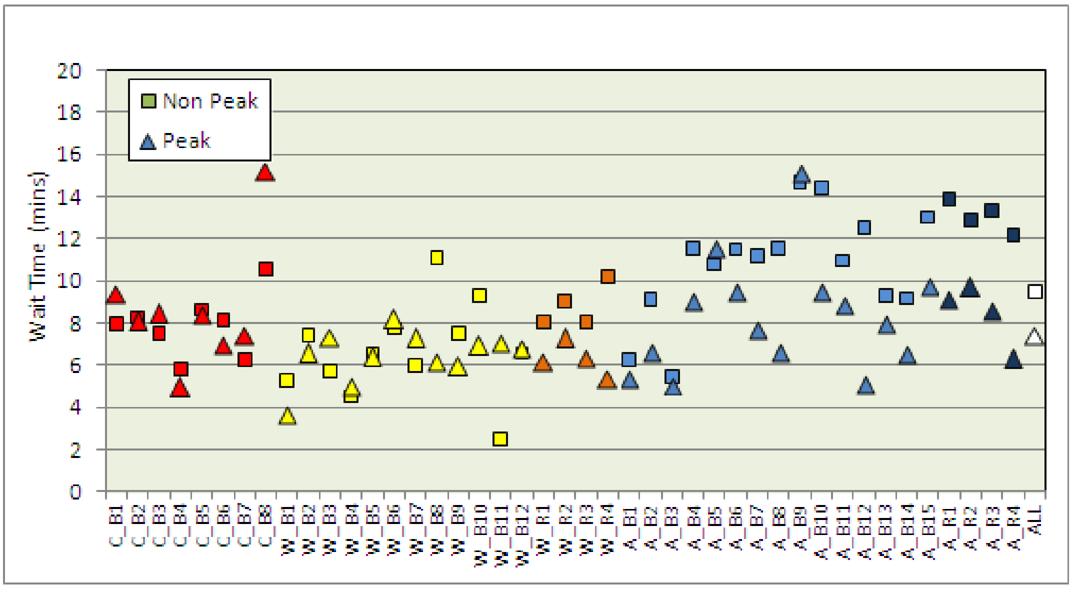
Wellington wait times tended to be lower than in Christchurch and Auckland. The longest was 11.1 minutes on Eastbourne/Wainuiomata services (W_B8) in the non-peak. Average waits for Wellington trains ranged between 8 and 10.2 minutes (Wairarapa) in the non-peak and 5.3 to 7.2 minutes in the peak.

Non-peak waits for Auckland rail services were longer ranging from 12.2 to 13.9 minutes. Peak waits were lower ranging between 6.3 and 9.7 minutes.

The shortest wait was for the Wellington Newtown, Happy Valley and Island Bay bus service (W-B1) which averaged 3.6 minutes in the peak and 5.3 minutes in the non-peak.

The shortest wait in Christchurch was 4.9 minutes for West-South East services (C_4). For Auckland, the shortest wait was 5.1 minutes for peak Northern Express services (A_B3).

Figure 4.12 Wait time by city, mode, time period and aggregated route



4.5 Wait time and service interval

The survey, by asking questions on both wait and service interval enabled the assumption that 'passengers turn up at random and therefore wait half the service interval' on average to be tested. The survey data showed that the assumption would generally be the exception rather than the rule. In fact, only for a 15-minute service did the data match the assumption.

Table 4.7 provides a cross-tabulation of wait time and service interval. For each category of service interval, the wait time percentage is given.

Table 4.7 Wait time and service interval cross-tabulation

		Service interval category (mins)												
		< 8	8–12	13–17	18–22	23–27	28–32	33–37	38–42	43–47	48–52	53–57	58–62	>63
Wait time category (mins)	< 8	81%	67%	63%	56%	49%	50%	32%	39%	39%	44%	38%	36%	37%
	8–12	12%	21%	22%	23%	22%	25%	25%	30%	24%	19%	25%	26%	29%
	13–17	4%	5%	8%	10%	14%	9%	12%	10%	10%	4%	0%	10%	12%
	18–22	2%	4%	4%	6%	10%	8%	8%	10%	11%	26%	38%	11%	2%
	23–27	1%	0%	1%	1%	1%	2%	3%	1%	3%	4%	0%	3%	2%
	28–32	0%	1%	2%	2%	2%	4%	14%	5%	8%	0%	0%	7%	0%
	33–37	0%	0%	0%	0%	0%	0%	0%	2%	0%	0%	0%	1%	0%
	38–42	0%	0%	0%	0%	0%	1%	2%	0%	3%	0%	0%	3%	2%
	43–47	0%	0%	0%	0%	0%	0%	2%	1%	3%	0%	0%	1%	2%
	48–52	0%	0%	0%	0%	0%	0%	0%	2%	0%	0%	0%	1%	0%
	53–57	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%
	58–62	0%	0%	0%	0%	0%	0%	0%	2%	0%	4%	0%	2%	10%
	>63	0%	0%	0%	0%	0%	0%	2%	0%	0%	0%	0%	0%	2%
Sample		389	1,115	2,037	1,166	208	2,786	59	124	109	27	8	515	41

For the most frequent services when buses/trains were no more than eight minutes apart, 81% (unshaded) gave the same wait time as the service interval and 19% waited longer. Of the 19%, 12% waited between 8 and 12 minutes and 4% waited between 13 and 17 minutes (red shaded cells). These longer waits point to some service unreliability/irregularity.

For the 8 to 12 minute category (mainly services every 10 minutes) 21% waited the same time with 67% waiting less than the service interval (green shaded) and 12% waiting longer.

For the 28 to 32 minute category (mainly services every half hour), only 4% waited for the same time (ie 28 to 32 minutes) and only 1% waited for longer than the service interval. Half the respondents waited less than eight minutes and a quarter waited 8 to 12 minutes.

The average wait was estimated for each service interval. The service interval categories were changed from those in table 4.6 to improve precision (where sample sizes permitted).

There were 19 grouped observations after reclassification (table 4.8) which summarises 8,545 responses (where both wait times and service intervals were given by respondents). However, there was still a need to group some service interval values because of the low sample sizes. These are the non-integer values in the table. For example, observation 1 groups the one- and two-minute service interval observations and gives a service interval of 1.9 minutes for the 50 responses. However observation 5 was not grouped since there were 990 responses with a service interval of exactly 10 minutes.

Table 4.8 Predicting wait time based on service interval

	Observed						Predicted		
Obs	SI (mins)	Wait (mins)	Wait StD (mins)	Sample Size	Obs Weight	Wait/SI	Wait (Mins)	Error (mins)	Wait/SI
1	1.9	3.7	4.93	50	0.3	198%	3.1	-0.6	166%
2	3.3	4.4	4.61	38	0.3	136%	3.9	-0.5	119%
3	5.1	5.2	5	242	0.9	102%	4.7	-0.5	92%
4	7.5	4.8	4.67	110	0.6	63%	5.5	0.8	73%
5	10.0	6.7	6.63	990	1.8	67%	6.3	-0.4	63%
6	12.0	6.7	5.56	73	0.6	56%	6.8	0.1	57%
7	13.1	5.7	4.02	109	0.8	43%	7.1	1.4	54%
8	15.0	7.4	6.89	1,881	2.6	49%	7.5	0.1	50%
9	17.5	8.8	7.95	108	0.6	50%	8.1	-0.7	46%
10	20.0	8.3	7.63	1,088	2.0	42%	8.6	0.3	43%
11	22.7	8.8	7.49	48	0.5	39%	9.1	0.3	40%
12	25.0	9.9	8.11	169	0.9	39%	9.5	-0.3	38%
13	27.8	12.7	9.73	18	0.3	46%	10.0	-2.7	36%
14	30.0	9.7	8.71	2,776	3.3	32%	10.4	0.7	35%
15	34.9	13.8	10.45	59	0.6	39%	11.1	-2.7	32%
16	39.9	12.6	12.22	124	0.6	32%	11.8	-0.8	30%
17	45.0	12.9	10.92	109	0.7	29%	12.5	-0.4	28%
18	50.3	11.9	11.57	30	0.3	24%	13.2	1.3	26%
19	60.0	13.8	12.56	523	1.4	23%	14.4	0.6	24%
All	23.4	8.7	8.4	8,545	19	37%	9.2	0.5	39%

Figure 4.13 presents the observations and the fitted function. As well as the average wait times, the standard error of the estimate is shown (the upper and lower bars). Generally, observations with a large sample had a narrow range.

To reflect the difference in sampling accuracy, the observations were weighted in relation to their t value (mean over the standard error), as in equation 4.1 while maintaining the number of observations (19). This gave 2.6 times more weight to the 15-minute service interval observation which had a sample size of 1,881, but only a weight of 0.3 to the service interval observation of 50.3 minutes which had a sample size of 30.

$$w_i = 19\left\{ Av(Wait)_i \div \left[\frac{StDev(Wait)_i}{\sqrt{N_i}} \right] \right\}$$ (Equation 4.1)

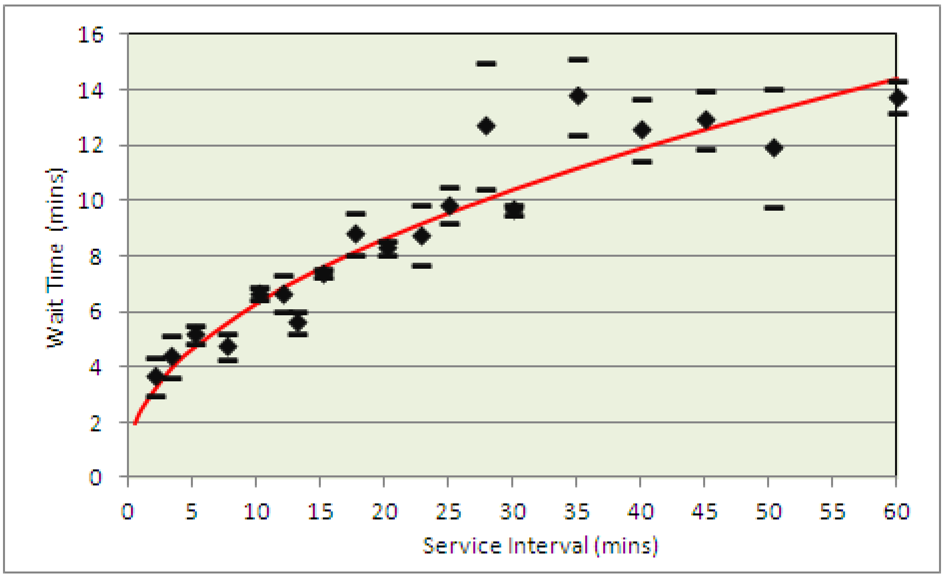
The most appropriate model was non-linear with waiting time increasing at the square root of the service interval, equation 4.2. Other powers were tried but 0.5 was found to produce the best fit. The service interval parameter was 1.767 (t value of 10.8) with a constant of 0.681 (t of 0.91).

$$Av(wait) = 0.681 + 1.767(\sqrt{SI})$$ (Equation 4.2)

(0.91) (10.8)

The predicted wait times are presented in the right-hand columns of table 4.7. For high-frequency services, the average wait time was much higher than the assumption of half the headway (service interval). For example, for a service interval of 5.1 minutes, the predicted wait was 4.7 minutes compared with the observed average of 5.2 minutes. Thus instead of 2.55 minutes (half the headway) the wait time was 4.7 minutes which was 92% of the headway.

Figure 4.13 Wait time and service interval



The wait time percentage reduced as headway increased so that at 15 minutes, the conventional assumption of half the headway was predicted. After this point, the wait time percentage dropped below 50% so that for services every 20 minutes, the average wait was predicted at 8.6 minutes or 43% of the service interval. For a half-hourly service, the predicted wait was 10.4 minutes or 35% of the service interval. Obviously, people do not turn up at random for less frequent services but instead consult a timetable.

The survey results suggest that halving the service interval is only valid for service frequencies around 15 minutes. For more frequent services, wait times tend to be longer and for less frequent services, wait times tend to be shorter than half the headway.

It is also worth stating that the prediction equation was based on average waiting times. There was in fact considerable variability around the average. Figure 4.14 shows the variability in perceived waiting times for respondents who estimated their service to be every 10 minutes. The average wait was 6.5 minutes but 23% of respondents waited for five minutes, 13% waited two minutes, 8% one minute and 8% zero minutes. Thus two thirds estimated their wait time to be less than 6.5 minutes. There was a 'long tail' for the third that waited longer than 6.5 minutes. Five percent waited for one quarter of an hour and 3% waited for 20 minutes. Figure 4.15 superimposes the predicted waiting times on the average wait. Although the predicted wait was a good fit there was a wide range in the wait times which is reflected in the standard deviation.

Figure 4.14 Perceived wait time for a service every 10 minutes

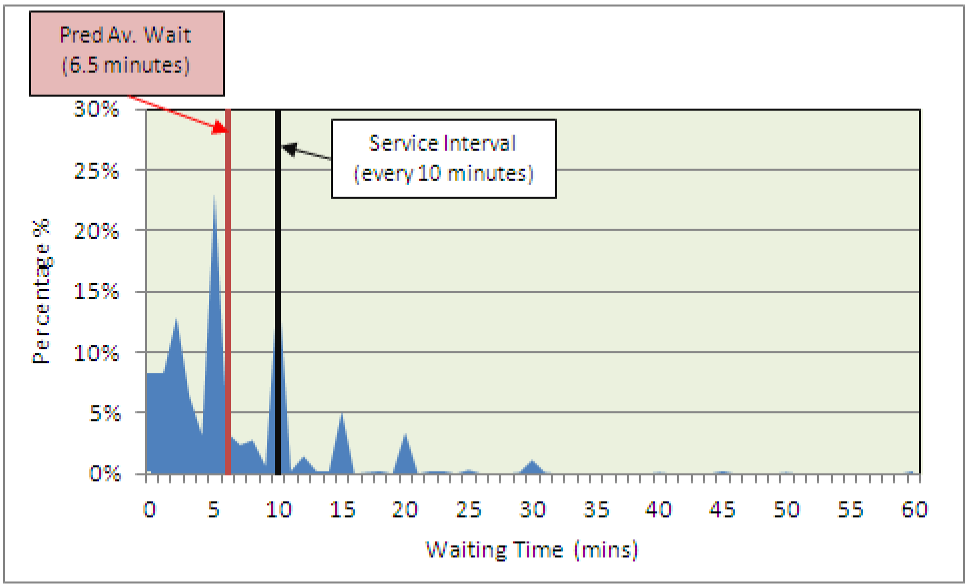
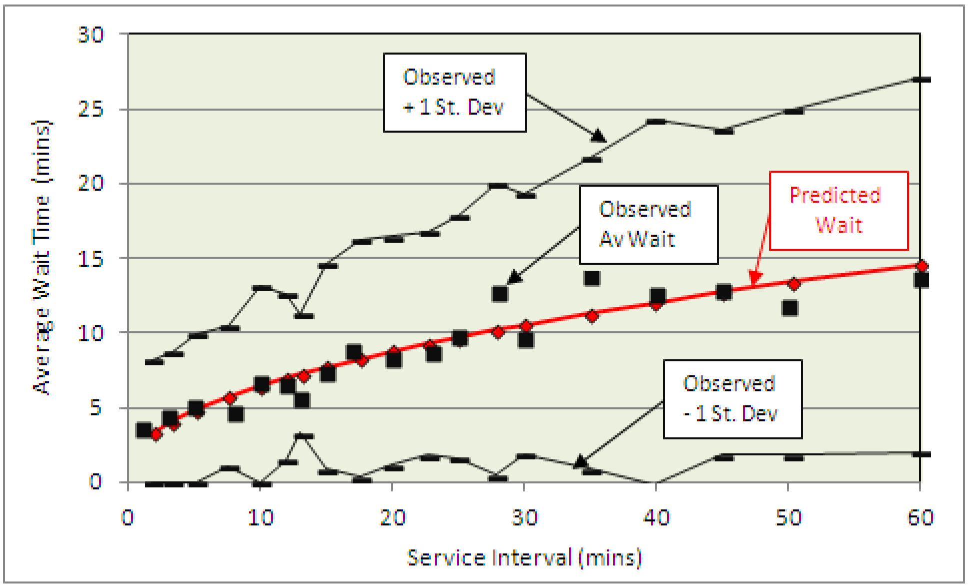


Figure 4.15 Predicted and observed variation in perceived wait time



4.6 Ticket type and fare

The SP survey asked the type of ticket and cost of the ticket *per trip*. The response ticket type was tailored to each city and mode to allow for different ticket types. The box below shows the question on the Auckland rail SP question. The response was then aggregated into the categories shown in table 4.9.

Figure 4.16 Auckland rail stated preference questionnaire

8. What type of ticket are you using? 1❐Adult Single/Cash 2❐Child Single/Cash
3❐ Hop/Money Adult 4❐ Hop/Money Tertiary 5❐ Hop/Money Child 6❐ Hop Monthly
7❐ Child Monthly Pass 8❐SuperGold Card 9❐Other *please specify*......................................

9. What is the cost of your ticket? $...................*per trip*

Table 4.9 Ticket type profile

Ticket type	Number of responses			Percent of valid responses		
	Rating	SP	All	Rating	SP	All
Single/cash	1,858	1,500	3,358	27%	28%	27%
Electronic card	1,743	1,603	3,346	25%	30%	27%
10 trip	1,042	561	1,603	15%	11%	13%
Monthly	813	489	1,302	12%	9%	11%
Child single	365	247	612	5%	5%	5%
Child 10-trip	27	26	53	0%	0%	0%
SuperGold Card	529	275	804	8%	5%	7%
Tertiary pass	349	247	596	5%	5%	5%
Other	78	259	337	1%	5%	3%
Child electronic card	34	53	87	0%	1%	1%
School pass	10	5	15	0%	0%	0%
Card pass	7	0	7	0%	0%	0%
Day pass	83	0	83	1%	0%	1%
Weekly pass	18	0	18	0%	0%	0%
War pensioner/disabled	2	0	2	0%	0%	0%
Staff	6	0	6	0%	0%	0%
Total	6,964	5,265	12,229	100%	100%	100%

Figure 4.17 aggregates the responses by adding the adult and child ticket types together. The overall ticket type profiles for the rating and SP questionnaires were similar. Including children, 58% used either a single/cash ticket or an electronic card such as the MetroCard on Christchurch buses, the Snapper card on Go Wellington buses and the HOP card on Auckland trains. Equal numbers of adults used single/cash (27%) as an electronic card (27%) with 5% of respondents using a child single and 1% using a child electronic card.

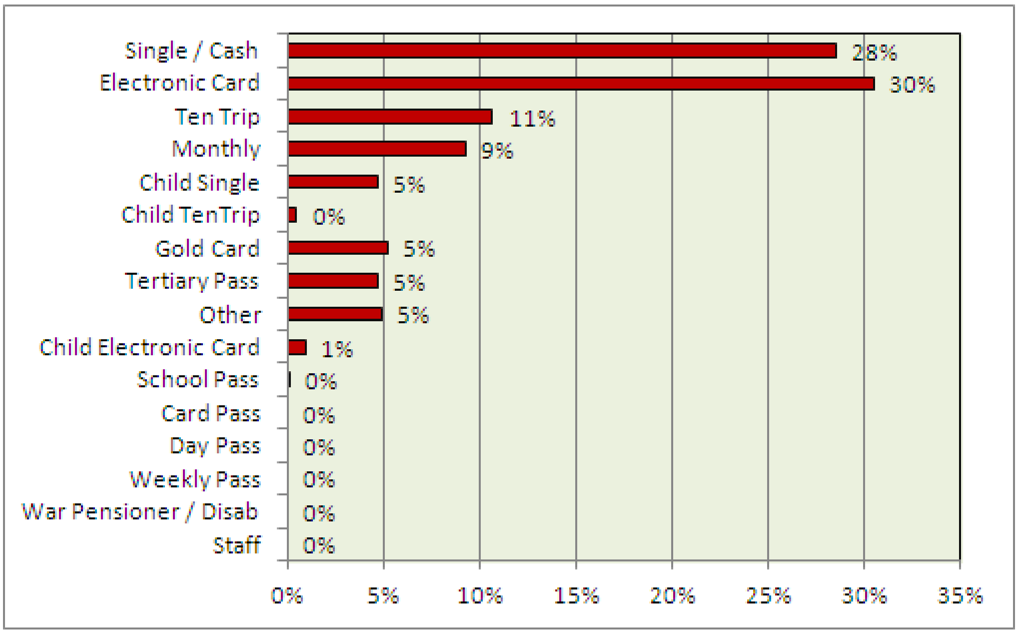
The 10-trip and monthly were the only other ticket types with over 10% shares.

The SuperGold Card, which allows people over 65 to travel free on buses outside the peak, had a 7% share.[12] The share was higher on the rating survey (8%) than on the SP survey (5%) reflecting the survey distribution.

In Auckland, 5% were travelling on a student's tertiary pass.

[12] People entitled to receive a SuperGold Card need to be (i) 65 and over and legally resident in NZ, (ii) under 65 and receive the non-qualified spouse or partner rate of NZ Super or Veteran's Pension or (iii) under 65 and receive the Veteran's Pension.

Figure 4.17 Ticket type profile – all responses



The profile reflected the tickets available in the three cities as can be seen in table 4.9 and figure 4.18 (which adds the adult and child ticket types together).

For Christchurch, two thirds of respondents used the Metrocard with 19% of peak and 24% of non-peak respondents paying cash for a single ticket. Non-peak SuperGold Card use, at 12%, was the highest of the three cities.

On Wellington buses, single/cash use was higher than in Christchurch with 22% of peak and 29% of non-peak users. On peak rail services, the single/cash share fell to 12% but increased to 35% in the non-peak. Electronic card use on Wellington buses was 62% in the peak and 47% in the non-peak. Ten percent used a SuperGold Card on non-peak buses and trains. For rail, the 10 trip was the most used ticket type in the peak with 49%. In the non-peak, the percentage reduced to 31%. Monthly tickets were also popular accounting for 35% of peak and 16% of non-peak response.

In Auckland, an electronic 'HOP' card had just been introduced onto rail services but not onto buses. There were still electronic cards such as the Snapper available on buses, however, and a third of peak bus respondents used one of these cards. On rail, the HOP card was used by 41% of peak and 24% of non-peak respondents. Auckland buses had the highest single/cash use with 41% of peak and 51% of non-peak. Tertiary passes that offered students a third off the standard fare were used by 10% of bus respondents and 15% of rail respondents.

Table 4.10 Ticket type profile by city, mode and time period

Ticket type	Peak						Non-peak					
	Bus			Rail		All	Bus			Rail		All
	CHC	WTN	AUC	WTN	AUC		CHC	WTN	AUC	WTN	AUC	
Single/cash	17%	20%	33%	12%	19%	20%	19%	25%	41%	35%	31%	32%
Electronic card	65%	62%	34%	0%	39%	28%	57%	47%	20%	0%	22%	27%
10 trip	3%	1%	3%	49%	0%	21%	2%	3%	4%	31%	0%	8%
Monthly	0%	6%	6%	35%	16%	19%	0%	3%	4%	16%	4%	6%
Child single	2%	2%	8%	0%	4%	3%	5%	5%	10%	0%	12%	6%
Child 10 trip	0%	0%	1%	0%	0%	0%	0%	0%	2%	0%	0%	1%
SuperGold Card	7%	4%	3%	1%	1%	2%	12%	10%	7%	10%	9%	9%
Tertiary pass	1%	0%	10%	0%	15%	4%	1%	0%	9%	0%	16%	5%
Other	1%	4%	2%	1%	1%	2%	1%	6%	2%	5%	1%	3%
Child electronic card	5%	0%	0%	0%	2%	1%	4%	0%	0%	0%	2%	1%
School pass	0%	0%	0%	0%	1%	0%	0%	0%	0%	0%	0%	0%
Card pass	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%
Day pass	0%	0%	1%	0%	0%	0%	0%	1%	1%	1%	1%	1%
Weekly pass	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%
War pensioner/disab	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%
Staff	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%
Total	229	825	1,112	1,850	589	4,605	1,116	1,603	2,453	1,524	928	7,624

Figure 4.18 Ticket type profile by city, mode and time period

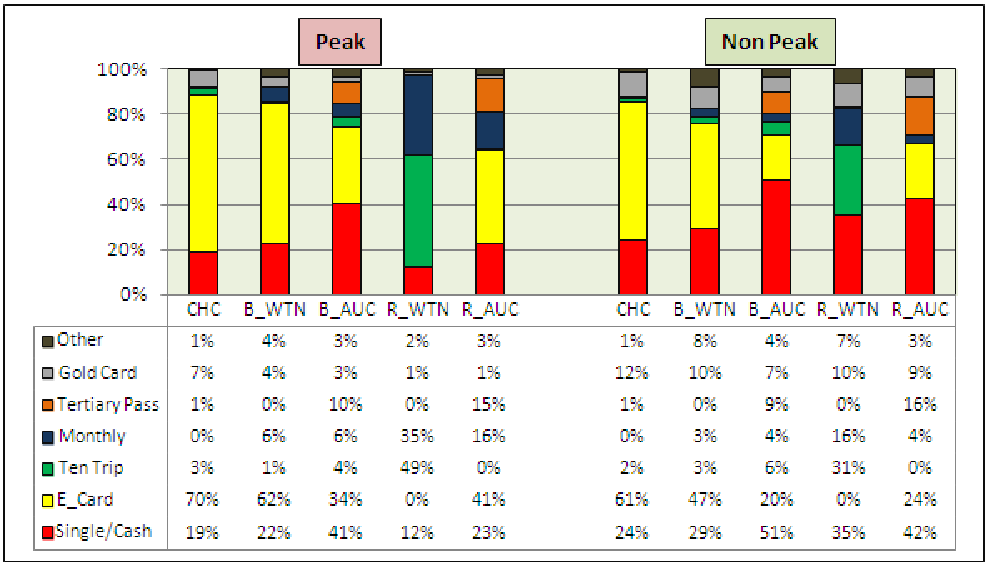


Figure 4.19 presents the percentage of respondents using single tickets by aggregated route. It should be noted that SuperGold Card users who paid for a single ticket are not included. Appendix B, table B.13 (see part 3 of this report) presents the shares for the main ticket types by aggregated route.

The lowest share of single ticket use was 10% on peak Wellington trains. In the non-peak, the percentage rose to over 30% on the three 'metro lines' and to over 50% on the Wairarapa line.

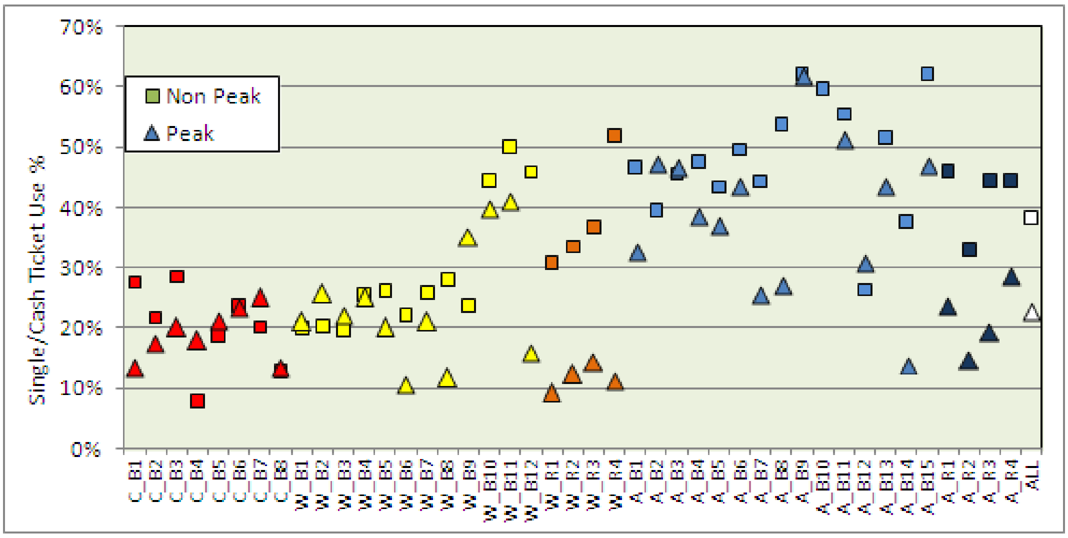
Christchurch single ticket usage ranged between 8% and 30% with non-peak usage tending to be highest.

Single ticket use on Go Wellington buses was similar to Christchurch but use in the Hutt Valley (W_B9) and on Mana services was higher with a third to one half of respondents paying cash. Single ticket use was also high at 46% on the Airport Flyer on non-peak services but fell to 15% on peak services.

There was a wide spread in the single/cash share across the Auckland bus routes. CBD–North Shore (A_B14) had the lowest share of 14% in the peak with two routes, the NW (220–233) and SW (358–287) having shares in the mid 20%. Most routes had shares in the 30% to 50% range with the Far South Papakura 400s (A_B10) South Manukau 300s (A_B9) and Intra North Shore (A_B15) exceeding 60%.

Auckland rail had a higher single ticket use than Wellington rail with peak percentages ranging from 15% to 30% and non-peak shares ranging from 33% to 46%.

Figure 4.19 Single/cash use (%) by aggregated route and time period



4.7 Average fare per trip

Only the SP questionnaire asked passengers about the level of fare paid for their trip. The sample sizes were therefore lower. Although the question asked for the fare per trip, some respondents, especially monthly and 10-trip users, gave the ticket price. This was then recalculated as a price per trip by dividing by an assumed number of trips (ie 10 for a 10-trip).

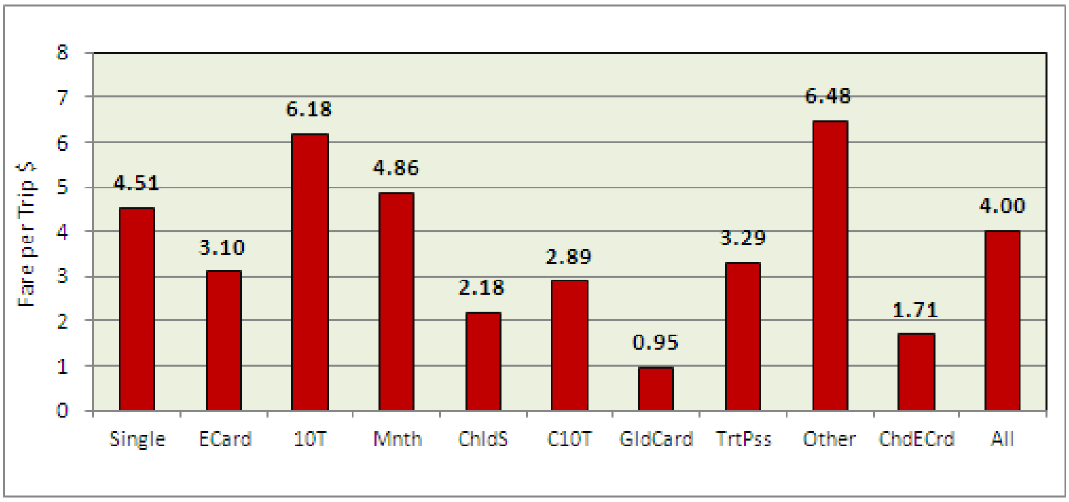
The number of respondents who answered the fare question varied by ticket type as can be seen in table 4.10. The highest percentage completing the question was by single/cash payers with only 3% not giving a fare. By contrast, 17% travelling on electronic cards did not give a fare. Several wrote on their questionnaire that they did not know how much they were paying per trip. Others remarked to interviewers that they did not know how much their card would debit. There was a much higher 'non-response' among monthly ticket users with 31% not giving a fare.

The overall average fare was $4 per trip.[13] The lowest was 95 cents per trip for SuperGold Card users reflecting the proportion travelling free in the non-peak. The highest fare was $6.48 per trip for the 'other' ticket type. This figure should be treated with some caution, however, given the inexactitude in calculating the 'per trip' cost.

Table 4.11 Average fare per trip by ticket type

Ticket type	Average fare $/trip			Response to question			
	Mean	Std dev	Std error	Fare	Ticket type	Non-response	Fare non-response %
Single/ash	4.51	2.80	0.07	1,462	1,500	38	3%
Electronic card	3.10	1.58	0.04	1,313	1,603	290	18%
10-trip	6.18	3.08	0.13	485	561	76	14%
Monthly	4.86	2.51	0.11	335	489	154	31%
Child single	2.18	1.00	0.06	239	247	8	3%
Child 10-trip	2.89	1.83	0.36	20	26	6	23%
SuperGold Card	0.95	2.06	0.12	253	275	22	8%
Tertiary pass	3.29	1.76	0.11	211	247	36	15%
Other	6.48	3.99	0.25	215	259	44	17%
Child electronic card	1.71	0.65	0.09	51	53	2	4%
Total	4.00	2.79	0.04	4,584	5,265	681	13%

Figure 4.20 Average fare per trip by ticket type



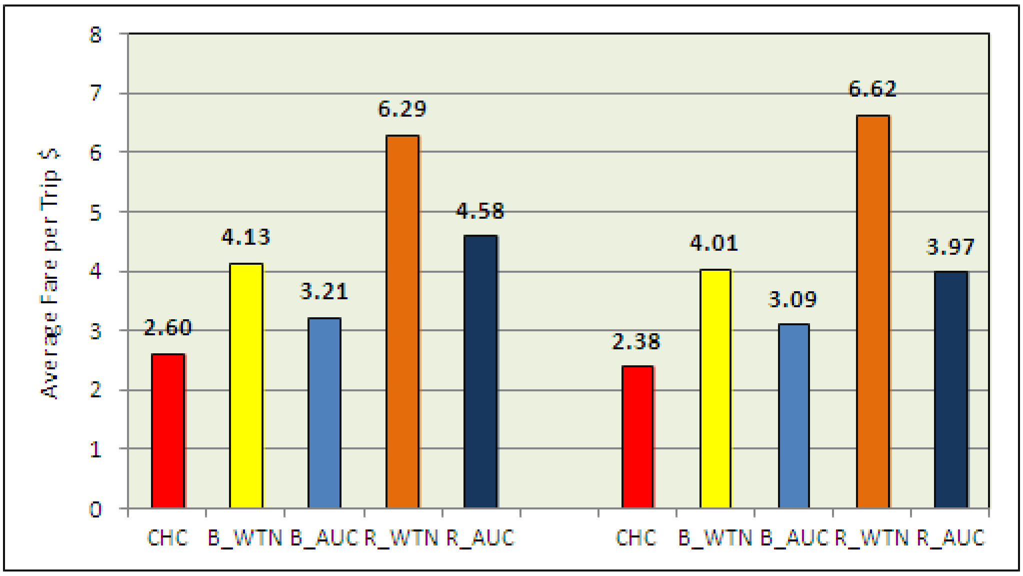
For single ticket users, the average fare was $4.51 which was 45% more than the $3.10 paid by electronic card users. At $6.18 per trip, the 10-trip was the second highest, with the monthly third at $4.86. The profile of the fare paid per trip is presented in table 4.12 with the average fare given at the bottom of the table. The average fare is graphed in figure 4.21.

[13] The average was very similar if calculated on the ticket type share (as opposed to the fare response percentage).

Table 4.12 Profile of fare per trip by city, mode and time period

Ticket type	Peak						Non-peak					
	Bus			Rail		All	Bus			Rail		All
	CHC	WTN	AUC	WTN	AUC		CHC	WTN	AUC	WTN	AUC	
Free	1%	1%	1%	0%	0%	1%	7%	6%	5%	5%	10%	6%
$0.01-$1.99	14%	12%	34%	1%	5%	15%	20%	11%	31%	1%	8%	19%
$2-$3.99	81%	48%	34%	32%	23%	40%	70%	48%	36%	19%	30%	42%
$4-$5.99	3%	21%	25%	22%	53%	24%	2%	16%	21%	19%	39%	17%
$6-$7.99	1%	8%	5%	15%	17%	9%	1%	5%	5%	24%	10%	7%
$8-$9.99	0%	7%	0%	12%	1%	5%	0%	13%	1%	13%	1%	5%
$10-$14.99	0%	3%	1%	16%	1%	5%	0%	1%	2%	17%	2%	4%
$15-$19.99	0%	1%	0%	1%	0%	1%	0%	0%	0%	2%	1%	0%
Average	2.60	4.13	3.21	6.29	4.58	4.35	2.38	4.01	3.09	6.62	3.97	3.78
Std dev	0.90	2.41	1.92	3.42	1.52	2.78	1.17	2.63	1.93	3.73	2.58	2.77
Std dev/av	35%	58%	60%	54%	33%	64%	49%	66%	62%	56%	65%	73%
Std error	0.07	0.13	0.08	0.16	0.12	0.07	0.05	0.10	0.06	0.17	0.22	0.05
Sample	145	371	513	458	165	1,652	548	649	1,149	486	143	2,975

Figure 4.21 Average fare per trip by city, mode and time period



Christchurch bus respondents tended to pay the least averaging $2.38 per trip in the non-peak and $2.60 in the peak. For Auckland, the average fare was $3.09 per trip in the non-peak and $3.21 in the peak. The highest fares were paid in Wellington at $4.01 per trip in the non-peak and $4.13 in the peak.

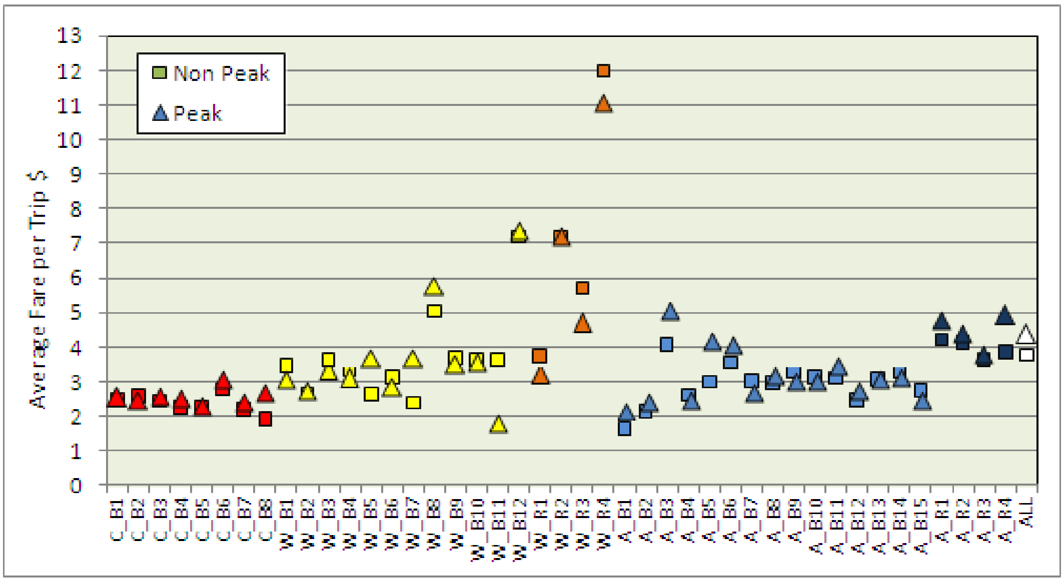
The average fare paid on Auckland trains was around a dollar higher than on Auckland buses. In the peak, the rail fare averaged $4.58 per trip and in the non-peak it averaged $3.97.

The highest fares per trip were on Wellington trains. The average fare in the peak was $6.29 with the non-peak fare 30c higher at $6.62 per trip.

There was considerable variation in the fares paid in Wellington and Auckland but less so in Christchurch. This is reflected in the spread in the fare categories in table 4.11. The variation was also reflected in the high standard deviation (over half the size of the average fare for peak Wellington bus users).

Figure 4.22 graphs the average fare by aggregated route. Appendix B, table B.14 presents the figures. The 'outlier' was the Wairarapa rail service which had a fare of $11 in the peak and $12 in the non-peak reflecting the longer trip lengths.

Figure 4.22 Average fare per aggregated route and time period



There was little variation in the Christchurch bus fares which reflects the simple flat fare system.

Apart from the 'commercial' Airport Flyer where the fare averaged $7 per trip and the longer distance Eastbourne/Wainiuomata service (fares of between $5 and $6), there was little difference across the Wellington bus routes. The lowest average fare was on the Paraparaumu 'local' services at less than $2 per trip.

The average fare on the three 'metro' Wellington rail services ranged from $3 to $4 on the shorter distance Johnsonville line to $4.70 to $5.70 on the Hutt Valley line and $7.20 on the Kapiti line.

The average fare on Auckland bus routes ranged from $2 on the short distance City Link and Inner Loop services (A_B1) to $4 to $5 on the Northern Express.

There was less range in the rail fares across the Auckland rail routes with averages of $3.60 to $4.90 per trip.

4.8 Fare paid and onboard travel time

There was a strong relationship between the fare per trip and the time spent on the bus or train as can be seen in figure 4.23. The derivation of the data points is provided in table 4.13 and as can be seen in the graph, the relationship is virtually a straight line.

Figure 4.23 Average fare paid with onboard time

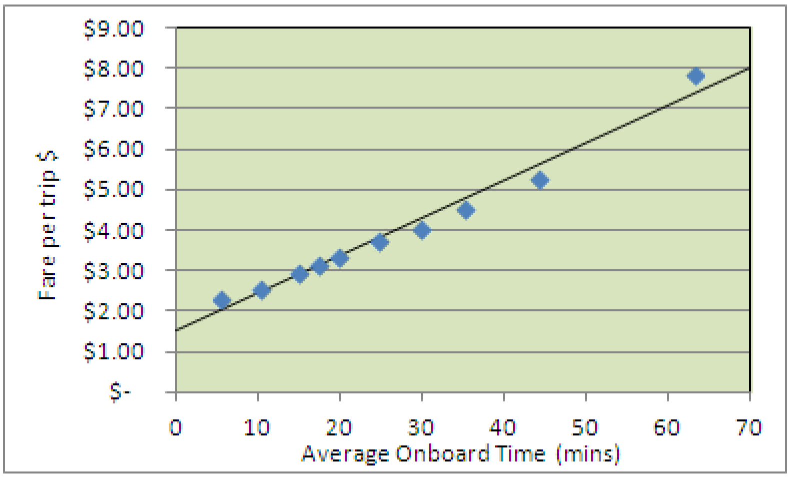


Table 4.13 Average fare paid with onboard time

Obs	Onboard time mins		Fare $		Sample size
	Class	Average	Average	$/Min	
1	2-9	5.7	2.33	0.41	279
2	10-14	10.4	2.56	0.25	556
3	15	15.0	2.98	0.20	522
4	16-19	17.5	3.14	0.18	87
5	20	20.0	3.38	0.17	819
6	21-25	24.7	3.77	0.15	390
7	26-30	29.9	4.06	0.14	524
8	31-39	35.3	4.54	0.13	167
9	40-50	44.1	5.28	0.12	592
10	51-180	63.1	7.84	0.12	436
All	All	26.9	4.02	0.15	4372

The fitted line presented in equation 4.3 (with t values in brackets) was $1.52 plus 9 cents per minute of onboard time. Thus the average fare for a 20 minute trip would be $3.32.

$$AvFare = 1.52 + 0.09(IVT) \qquad \text{(Equation 4.3)}$$

(9.7) (18.5)

Figure 4.24 standardises the average fares paid for each of the aggregated routes by dividing by the average onboard trip time (appendix B, table B.15 – see part 3 of this report).

The graph, which combines the peak and non-peak response, gives an average fare per minute of 15 cents with the statistic ranging from 7 cents per minute on the Far North Christchurch bus service to 26 cents per minute on the Wellington Airport Flyer.

The graph shows that for Christchurch, the fare per minute declined from 13 cents to 7 cents reflecting the increase in trip length from 19 to 29 minutes.

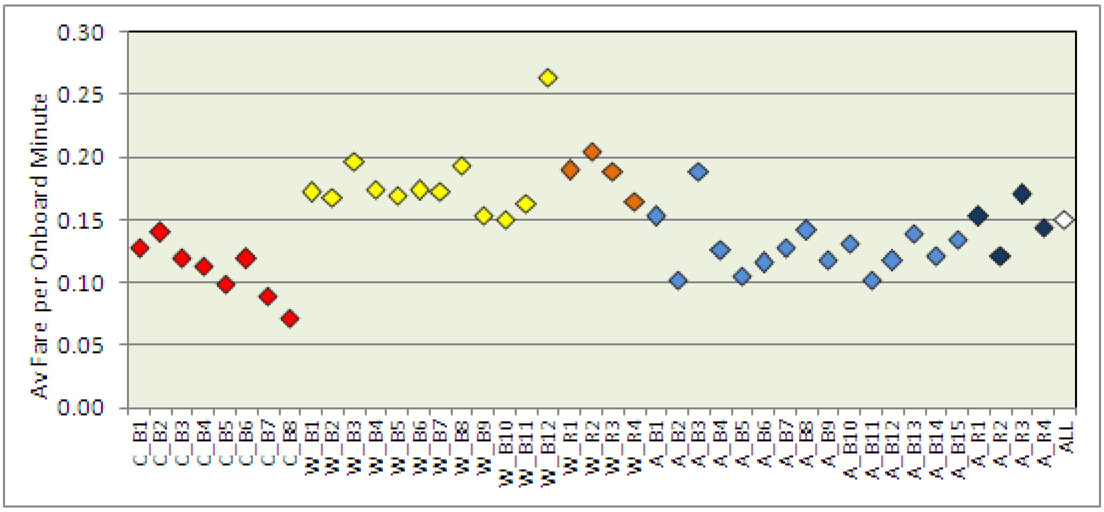
For Wellington buses, the fare per minute was reasonably similar ranging from 15 to 20 cents per minute, with the Airport Flyer (B_12) an exception.

For Wellington rail, the fare per minute fell from around 20 cents for the three metro routes to 16 cents for the longer distance Wairarapa route (W_R4).

For the Auckland bus routes, fare was typically in the 10 to 15 cents per minute band with a higher figure for the Northern Express (A_B3) of 19 cents per minute. This placed Auckland buses between Christchurch (lower) and Wellington (higher).

Similarly, Auckland rail fares were cheaper per minute than their Wellington metro counterparts ranging between 12 and 17 cents per minute.

Figure 4.24 Average fare per onboard minute by route and time period



5 Vehicle ratings

5.1 Introduction

A major component of the study was to elicit opinions on the quality of bus and rail and to do this respondents were asked to rate their bus or train and their bus stop or train station. This chapter analyses the vehicle ratings and chapter 6 looks at the bus stop and train station ratings.

Section 5.2 lists the vehicle attributes and section 5.3 describes how the five-point and nine-point scales were transformed onto the same percentage basis with 0% representing very poor, 50% average and 100% very good. Sections 5.4 to 5.23 present the vehicle ratings using different aggregations.

5.2 Vehicle attributes and response rates

Thirteen vehicle attributes were included in the bus and train rating surveys. The attributes are listed in table 5.1. On the longer-distance Wairarapa rail line, the 'availability and cleanliness of toilets' was included as an extra attribute.

The same descriptions were given on the bus and train questionnaires except for the driver/staff attribute. The bus questionnaire asked passengers to rate 'your driver'; the rail questionnaire asked passengers to rate the 'staff on board the train'.

Figure 5.1 Vehicle attributes rated

	Attribute
a	Your bus/train's outside appearance
b	Ease of getting on & off the bus/train
c	Seat availability & comfort
d	Space for personal belongings
e	Smoothness & quietness of ride
f	Heating & air conditioning
g	Lighting
h	Inside cleanliness & graffiti
i*	Availability & cleanliness of toilets*
j	On-bus/train information & announcements
k	Ability to use your computer & internet connectivity (WIFI)
l	Your bus driver / staff onboard train
m	Your bus/train's environmental impact (emissions, noise)
n	Your overall rating of this bus/train

* only asked on longer distance Wairarapa train service

The questionnaire 'instructions' advised those respondents who did not have a view on a particular attribute to leave the rating blank. Few respondents did not give a rating however. Response rates were around 95% as shown in table 5.1. The highest response rates of 96% were for attributes at the top of the list. For the overall vehicle rating given at the bottom of the list, the response rate was slightly lower at 94%. For the SP questionnaire, where only the overall vehicle rating was asked, a higher response of 97% was achieved.

There were three attributes where response was noticeably lower: computer/wifi, environmental impact and toilet availability/cleanliness.

For the 'ability to use your computer and internet connectivity (wifi)' a third did not express an opinion. For toilet availability and cleanliness, just under a fifth did not give a rating (Wairarapa rail service only)[14] and for the environmental impact rating (emissions, noise) one in eight did not provide a rating.

Table 5.1 Vehicle attributes rated

Attributes	Rating			Stated preference		
	Resp	Total	Resp %	Resp	Total	Resp %
Outside appearance	6,883	7,201	96%	-	-	-
Ease of on and off	6,889	7,201	96%	-	-	-
Seat av and comfort	6,877	7,201	96%	-	-	-
Space for bags	6,813	7,201	95%	-	-	-
Smoothness and quietness	6,846	7,201	95%	-	-	-
Heating and air con	6,805	7,201	95%	-	-	-
Lighting	6,734	7,201	94%	-	-	-
Inside clean and graf	6,820	7,201	95%	-	-	-
Toilet av and cleanliness	105	127	83%	-	-	-
Info and announcements	6,556	7,201	91%	-	-	-
Computer and internet	4,897	7,201	68%	-	-	-
Driver/staff	6,766	7,201	94%	-	-	-
Environmental impact	6,306	7,201	88%	-	-	-
Overall rating	6,800	7,201	94%	5,190	5,356	97%

5.3 Discussion of rating measures

Two rating scales were used; a nine-point scale was used in the rating survey and a five-point scale in the SP survey. In both scales the end points were labelled very poor (1) and very good (9) with the midpoint labelled as average.[15] Figure 5.2 shows the bus vehicle rating question which used a nine-point scale for greater fidelity.

[14] In the descriptive analysis, the ratings are calculated for the valid responses (with passengers who left the attribute blank omitted). In the explanatory analysis model, the blank responses are included.

[15] A discussion of alternative rating approaches by Charles Sullivan is provided in appendix C.

Figure 5.2 Bus rating question – nine-point scale

11. Please rate the bus you are travelling on using a 1 to 9 scale where 1 is very poor and 9 is very good. *Please circle your rating or leave blank if you have no opinion.*

	Very Poor			Average			Very Good		
a. Outside appearance of the bus	1	2	3	4	5	6	7	8	9
b. Ease of getting on & off the bus	1	2	3	4	5	6	7	8	9
c. Seat availability and comfort	1	2	3	4	5	6	7	8	9
d. Space for personal belongings	1	2	3	4	5	6	7	8	9
e. Smoothness & quietness of ride	1	2	3	4	5	6	7	8	9
f. Heating and air conditioning	1	2	3	4	5	6	7	8	9
g. Lighting	1	2	3	4	5	6	7	8	9
h. Inside cleanliness and graffiti	1	2	3	4	5	6	7	8	9
i. On-bus information & announcements	1	2	3	4	5	6	7	8	9
j. Ability to use your computer, internet connectivity (WIFI) etc	1	2	3	4	5	6	7	8	9
k. Your driver	1	2	3	4	5	6	7	8	9
l. Environmental impact (emissions, noise)	1	2	3	4	5	6	7	8	9
m. Your overall rating of this bus	1	2	3	4	5	6	7	8	9

The SP survey used a five-point scale with the number of stars denoting the level of quality (figure 5.3).

The star system was preferred to the nine-point scale because it was easier to present on the SP show cards which had five levels of quality. The star system was also considered likely to be familiar to respondents given its use by the media to rate restaurants, hotels and movies.

Figure 5.3 Stated preference train rating question – five-point scale

7. Please rate the quality of this train in terms of its appearance, information, facilities, cleanliness, comfort and staff on a 1-5 scale where 1 is very poor and 5 is very good.

Please tick one box	1 Very Poor ★☆☆☆☆	2 Poor ★★☆☆☆	3 Average ★★★☆☆	4 Good ★★★★☆	5 Very Good ★★★★★
Train Rating					

The nine- and five-point scales were converted to the same percentage scale enabling the response to the two questionnaires to be combined as shown by equations 5.1 and 5.2.

Nine-point scale

$$R\% = 100\left[\frac{R9-1}{8}\right] \quad \text{(Equation 5.1)}$$

Five-point scale

$$R\% = 100\left[\frac{R5-1}{4}\right] \quad \text{(Equation 5.2)}$$

The ratings measured the average percentage out of 100 with 0% labelled as 'very poor' and 100% as 'very good'.

The average rating (AvR%) was the weighted sum of the percentage ratings (R%j) multiplied by the relative number of respondents giving each rating (Nj), equation 5.3.

$$AvR\% = \frac{1}{\sum_j N} \sum_j R\%_j N_j$$ (Equation 5.3)

Table 5.2 and figure 5.4 present the composition of the average rating for the rating and SP surveys. The computed average ratings were nearly identical: the rating survey averaged 72% and the SP survey was 1% lower at 71%.[16]

As can be seen from the two graphs, the SP response profile was necessarily 'taller' by virtue of having only four rating categories.

The averages of 70% were close to a 'good' rating (which would require a score of 75%). In fact, the most popular rating was 'good'. Out of 5,190 SP respondents 2,443 (47%) gave a rating of 4, and 2,075 out of 6,800 (31%) of rating survey respondents gave a score of 7.

Just over a fifth (22%) of SP respondents gave the top rating of 'very good'. For the rating survey, 13% gave a top score of 9 and 20% the next score down of 8.

By contrast, few respondents gave a 'very poor' rating. For the SP survey only 48 out of 5,190 (0.9%) gave a 'very poor' rating and for the rating survey, only 50 out of 6,800 (0.7%) gave a score of 1.

A 'poor' rating was given by 197 respondents in SP survey or 4% of the sample. For the rating survey 0.5% gave a score of 2 and 1.8% a score of 3.

An average rating of 3 out of 5 was given by 26% of SP respondents. For the rating survey 11% gave a midpoint rating of 5 with 17% a 6 and 5% a 4.

Table 5.2 Composition of the mean score rating

Label	Stated preference (five-point scale)				Rating survey (nine-point scale)			
	5pt	%R	N	%	9pt	%R	N	%
Very poor	1	0%	48	0.9%	1	0%	50	0.7%
					2	13%	35	0.5%
Poor	2	25%	197	3.8%	3	25%	122	1.8%
					4	38%	332	4.9%
Average	3	50%	1,350	26.0%	5	50%	753	11.1%
					6	63%	1,180	17.4%
Good	4	75%	2,443	47.1%	7	75%	2,075	30.5%
					8	88%	1,378	20.3%
Very good	5	100%	1,152	22.2%	9	100%	875	12.9%
Total	All	Na	5,190	100%	All	na	6,800	100%
Av rating (AvR%)	71%				72%			

[16] As the rating measure is expressed as a percentage score, reference to 'differences in percentages' strictly means the absolute difference in the two percentages score as opposed to the percentage difference. Some authors use 'percentage points difference' but it was decided to just refer to the percentage for brevity.

Figure 5.4 Composition of the mean score rating – overall vehicle rating

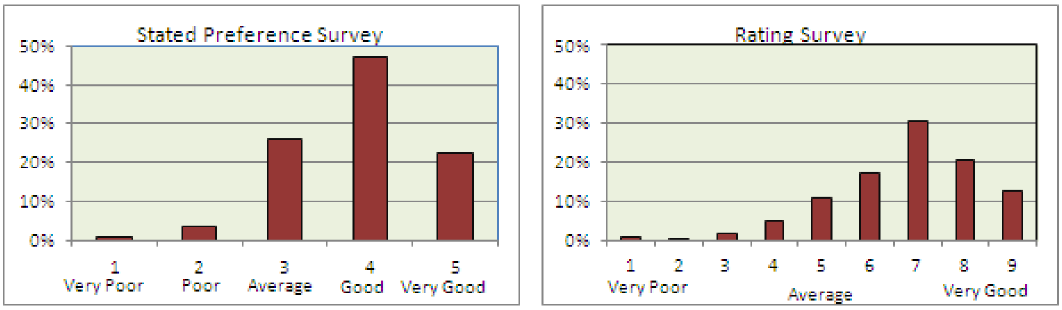


Table 5.3 presents the overall ratings by mode. As can be seen, the two surveys gave an identical 70% rating for bus (response combined for the three cities) with only a 2% difference for the train rating (74% rating and 76% SP). A discussion of the different ratings by city is left until section 5.4.

The spread in values was 'summarised' by the standard deviation which was calculated at 20%.[17] Given the large sample sizes, the sampling error was less than 1%.[18]

Table 5.3 Overall bus and train ratings by city and survey type

Mean %								
Survey	**CHC**	**WTN_B**	**AUC_B**	**All Bus**	**WTN_R**	**AUC_R**	**All Rail**	**All**
Rating	69%	69%	72%	70%	78%	67%	74%	72%
SP	68%	71%	70%	70%	79%	67%	76%	71%
All	68%	70%	71%	70%	78%	67%	75%	72%
Standard deviation (%)								
Survey	**CHC**	**WTN_B**	**AUC_B**	**All bus**	**WTN_R**	**AUC_R**	**All rail**	**All**
Rating	21%	18%	20%	19%	18%	21%	19%	19%
SP	20%	20%	21%	21%	20%	20%	21%	21%
All	21%	19%	20%	20%	18%	21%	20%	20%
Sample size (N)								
Survey	**CHC**	**WTN_B**	**AUC_B**	**All bus**	**WTN_R**	**AUC_R**	**All rail**	**All**
Rating	528	1,158	1,694	3,380	2,273	1,147	3,420	6,800
SP	752	1,216	1,807	3,775	1,067	348	1,415	5,190
All	1,280	2,374	3,501	7,155	3,340	1,495	4,835	11,990
Standard error (%)								
Survey	**CHC**	**WTN_B**	**AUC_B**	**All bus**	**WTN_R**	**AUC_R**	**All rail**	**All**
Rating	0.9%	0.5%	0.5%	0.3%	0.4%	0.6%	0.3%	0.2%
SP	0.7%	0.6%	0.5%	0.3%	0.6%	1.1%	0.6%	0.3%
All	0.6%	0.4%	0.3%	0.2%	0.3%	0.5%	0.3%	0.2%

[17] The percentage rating (R%) is not distributed as a binomial (100%,0%) with a standard deviation given by $\sigma = \sqrt{(R\%/100)(1-(R\%/100))}$ because of the intermediate points on the rating scale. In fact, the standard deviation was typically less than one half (around 45%) of the value of a binomial distribution. Finally, it should be noted that the sample was not a pure random sample of respondents but a 'clustered' sample of services and routes.

[18] Standard error was calculated as $\sigma / \sqrt{N}$.

5.4 Bus and train attribute ratings by city

Table 5.4 presents the ratings of the individual attributes from the rating survey and the overall rating in the bottom row which was calculated from both the rating and SP surveys. Also tabulated on the right-hand side are the sample sizes.

The ratings are graphed in figure 5.5. Wellington rail obtained the highest overall rating of 78% and Auckland rail the lowest rating of 67%. The range from top to bottom was therefore 11%. Christchurch, Wellington and Auckland buses achieved similar ratings, with Auckland highest at 71%, Wellington a percentage behind on 70% and Christchurch 3% behind on 68%.

The ratings of the individual attributes followed a similar pattern although there were some differences by city and by mode.

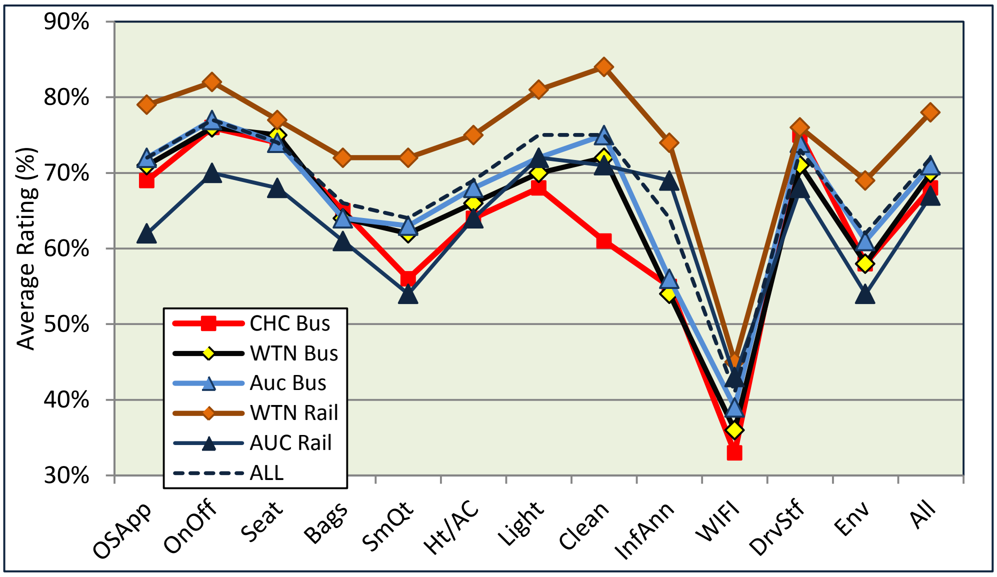
The highest rated attributes were *lighting* and *inside cleanliness and graffiti* with both scoring 75%. The lowest rated attribute and at 41% noticeably less than the others was the *ability to use your computer and internet connectivity*

Wellington rail rated highest for all attributes reflecting the recent introduction of new trains (Matangi rolling stock). The highest rated attribute was *cleanliness and graffiti* (84%) followed by *ease of getting on and off* (82%) and lighting (81%). Apart from *wifi* (45%), the lowest rated attribute at 69% was *environmental impact (noise and emissions.*

Table 5.4 Bus and train ratings by city

Attribute	Average rating %						Sample size					
	Bus			Rail		All	Bus			Rail		All
	CHC	WTN	AUC	WTN	AUC		CHC	WTN	AUC	WTN	AUC	
Outside appearance	69%	71%	72%	79%	62%	72%	534	1,167	1,719	2,292	1,171	6,883
Ease of on and off	76%	76%	77%	82%	70%	77%	542	1,171	1,709	2,296	1,171	6,889
Seat av and comfort	74%	75%	74%	77%	68%	74%	536	1,166	1,708	2,297	1,170	6,877
Space for bags	65%	64%	64%	72%	61%	66%	531	1,154	1,686	2,279	1,163	6,813
Smooth and quiet	56%	62%	63%	72%	54%	64%	537	1,156	1,695	2,296	1,162	6,846
Heating and air con	64%	66%	68%	75%	64%	69%	508	1,134	1,668	2,243	1,121	6,674
Lighting	68%	70%	72%	81%	72%	75%	504	1,129	1,655	2,281	1,165	6,734
Inside clean and graf	61%	72%	75%	84%	71%	75%	537	1,154	1,689	2,278	1,162	6,820
Toilet av and clean	na	na	na	76%	na	76%	na	na	na	105	na	na
Info and announce	55%	54%	56%	74%	69%	64%	498	1,056	1,620	2,230	1,152	6,556
Computer and internet	33%	36%	39%	45%	43%	41%	403	762	1,381	1,426	925	4,897
Driver/staff	75%	71%	74%	76%	68%	73%	533	1,141	1,696	2,266	1,130	6,766
Environ impact	58%	58%	61%	69%	54%	62%	503	1,027	1,629	2,032	1,115	6,306
All	68%	70%	71%	78%	67%	72%	1,280	2,374	3,501	3,340	1,495	11,990

Figure 5.5 Bus and train ratings by city



Auckland rail rated the lowest in seven attributes and second lowest in two attributes reflecting the older age of the diesel-hauled rolling stock which was programmed for replacement with new electric stock. *Smoothness and quietness* (54%), *environmental impact* (54%) and *outside appearance* (62%) scored comparatively lowly with *lighting* (72%), *inside cleanliness and graffiti* (71%) and *ease of getting on and off* (70%) scoring higher.

Christchurch, Wellington and Auckland buses rated similarly but there were some differences. The damaged roads caused by the Canterbury earthquakes contributed to a low rating of 56% for *smoothness and quietness* for Christchurch buses, whereas Wellington and Auckland scored just over 60% for this attribute.

Christchurch and Auckland bus drivers rated slightly higher at 75% and 74% respectively than Wellington at 71% but Christchurch buses scored lower at 61% for *inside cleanliness and graffiti* than Auckland at 75% and Wellington at 72%.

5.5 Bus and train ratings by aggregated route

The attribute ratings were analysed by route which were aggregated for some bus services due to low sample sizes. A summary is provided in table 5.5 with greater detail provided in appendix D (see part 3 of this report).

Table 5.5 Bus and train ratings by aggregated route

#	Attribute	Average rating (%)					Highest-rated route		Lowest-rated route	
		Av[(a)]	Max	Min	Range	SDv	Code	Name	Code	Name
1	Outside appearance	72%	86%	61%	25%	6%	AB2	Outer Loop	AR1	East line
2	Ease of on and off	76%	88%	68%	20%	5%	AB1	City Link, City Loop	AB10	Far S Papak (400s)
3	Seat av and comfort	75%	86%	64%	22%	5%	AB1	City Link,City Loop	AR4	West line
4	Space for bags	65%	79%	56%	23%	5%	WR1	Johnsonville	AB9	S.Manukau (300s)

#	Attribute	Average rating (%)					Highest-rated route		Lowest-rated route	
		Av[a]	Max	Min	Range	SDv	Code	Name	Code	Name
5	Smooth and quiet	62%	76%	46%	30%	7%	WR3	Hutt Valley	CB6	Airport Sumner (3,29)
6	Heating and air con	67%	80%	50%	30%	6%	WR1	Johnsonville	AB10	Far S Papak (400s)
7	Lighting	73%	85%	56%	29%	6%	WR1	Johnsonville	AB10	Far S Papak (400s)
8	Inside clean and graf	73%	89%	57%	32%	8%	AB3	Northern Express	AB10	Far S Papak (400s)
9	Info and announce	59%	89%	40%	49%	11%	AB2	Outer Loop	AB10	Far S Papak (400s)
10	Computer and internet	40%	70%	25%	45%	10%	WB12	Airport Flyer (91)	WB2	Uni/Mairangi (13,17,18)
11	Driver/staff	74%	85%	65%	20%	5%	AB1	City Link,City Loop	AR1	East line
12	Environ impact	60%	73%	49%	24%	7%	WR3	Hutt Valley	WB2	Uni/Mairangi (13,17,18)
13	Overall vehicle	71%	83%	63%	20%	5%	AB2	Outer Loop	AB10	Far S Papak (400s)

[a] unweighted average of aggregated route average scores (sample >20)

The averages are presented for routes with 20 or more observations.[19] For the overall vehicle rating (which was calculated using both the rating and SP responses), the average could be calculated for all 43 routes, but for the individual attribute ratings (calculated on only the rating response), four routes were excluded because their sample sizes were under 20.

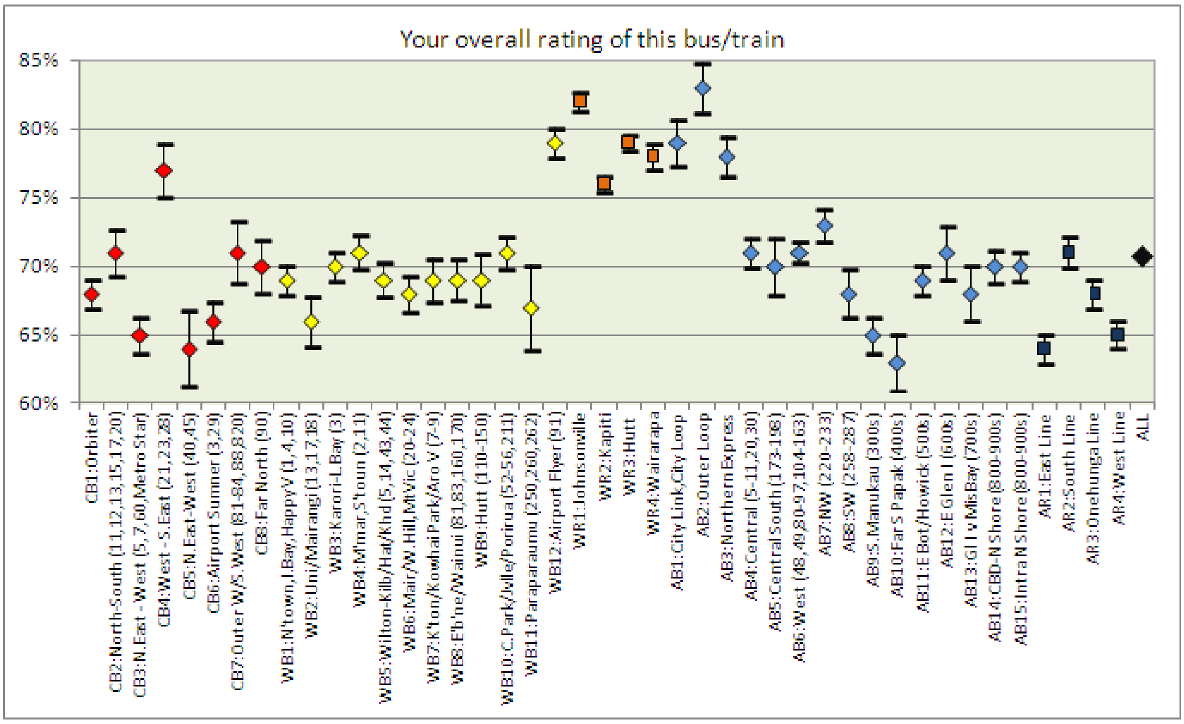
The overall route rating averaged 71% when calculated as the simple average across the 43 routes. The route average was therefore nearly the same as the average respondent average of 72% (table 5.4).

The route ratings ranged from a high of 83% for the Auckland Outer Loop service (AB2) down to a low of 63% for the Auckland Far South Papakura bus service (AB10). The range in route ratings was therefore 20%.

Figure 5.6 graphs the overall rating by route. The Wellington bus ratings were the most consistent scoring just under 70%. The exception was the Airport Flyer (WB12) which averaged 79% reflecting the premium service.

[19] The average is calculated as the unweighted mean of the route average scores rather than the average of the response as presented in section 5.4.

Figure 5.6 Overall vehicle rating by route



Wellington rail services rated highly ranging from 76% on the Kapiti line which had a mixture of new Matangi and old Ganz Mavag rolling stock to 82% on the Johnsonville line where all services were provided by the new Matangi trains.

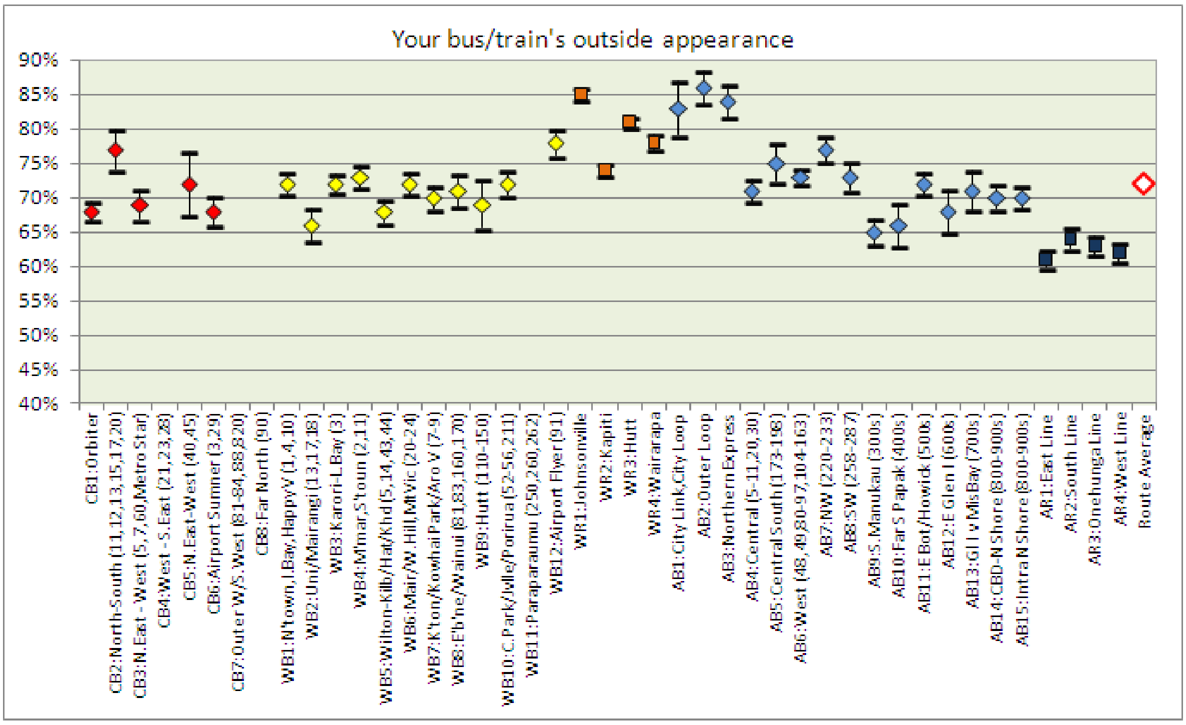
The rating of the Christchurch bus routes ranged from a high of 77% for the West – South East route (CB4) down to a low of 64% for the North East – West route (CB5).

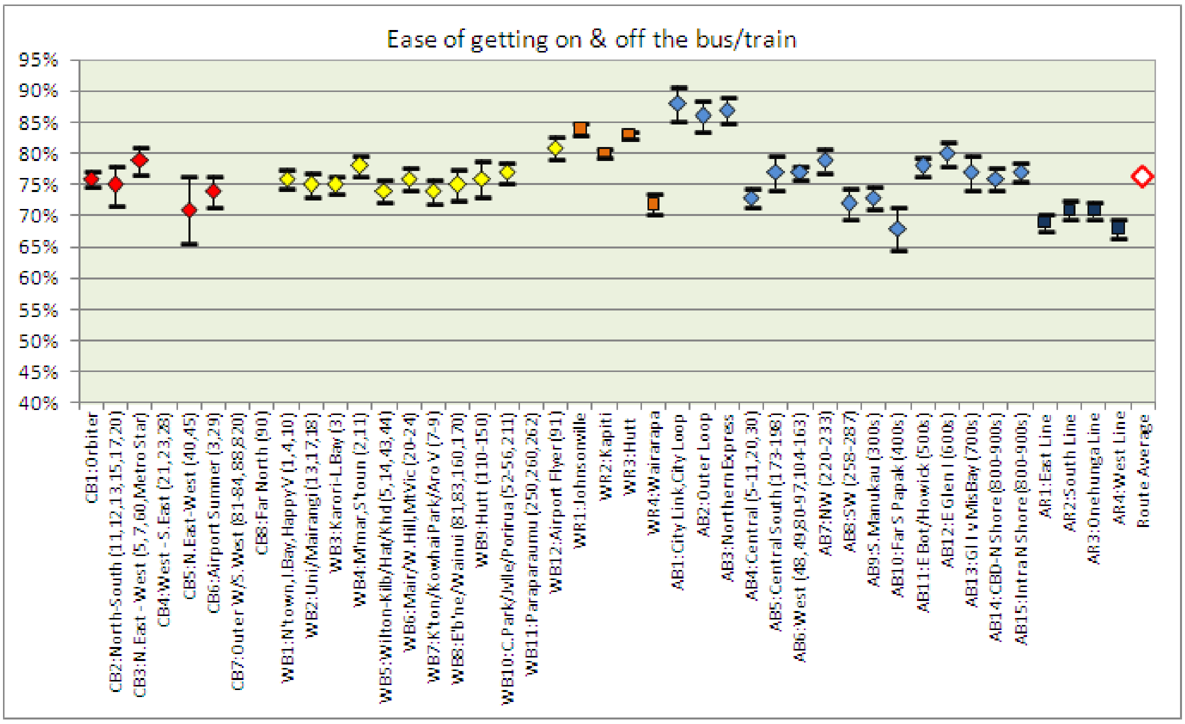
For Auckland, the three most highly rated routes were the Outer Loop (83%), City Loop/Inner Link (79%) and Northern Express (78%) bus services. All three bus routes were 'branded' higher quality services. All but two of the 'standard' bus routes rated around 70%. The two exceptions were the two southern bus routes, the Far South Papakura (AB10) and South Manukau (AB9) which scored 63% and 65%. For rail, the Onehunga and South lines rated slightly higher at 68% to 71% than the East and West rail lines at 64% to 65%.

Figures 5.7a to 57l graph the individual attributes in turn. The graphs follow a similar pattern to the overall vehicle rating. Routes that achieved a high overall rating tended to have high individual attribute ratings.[20] Nevertheless, some differences were evident as can be seen in the list of top and bottom rated routes in table 5.5.

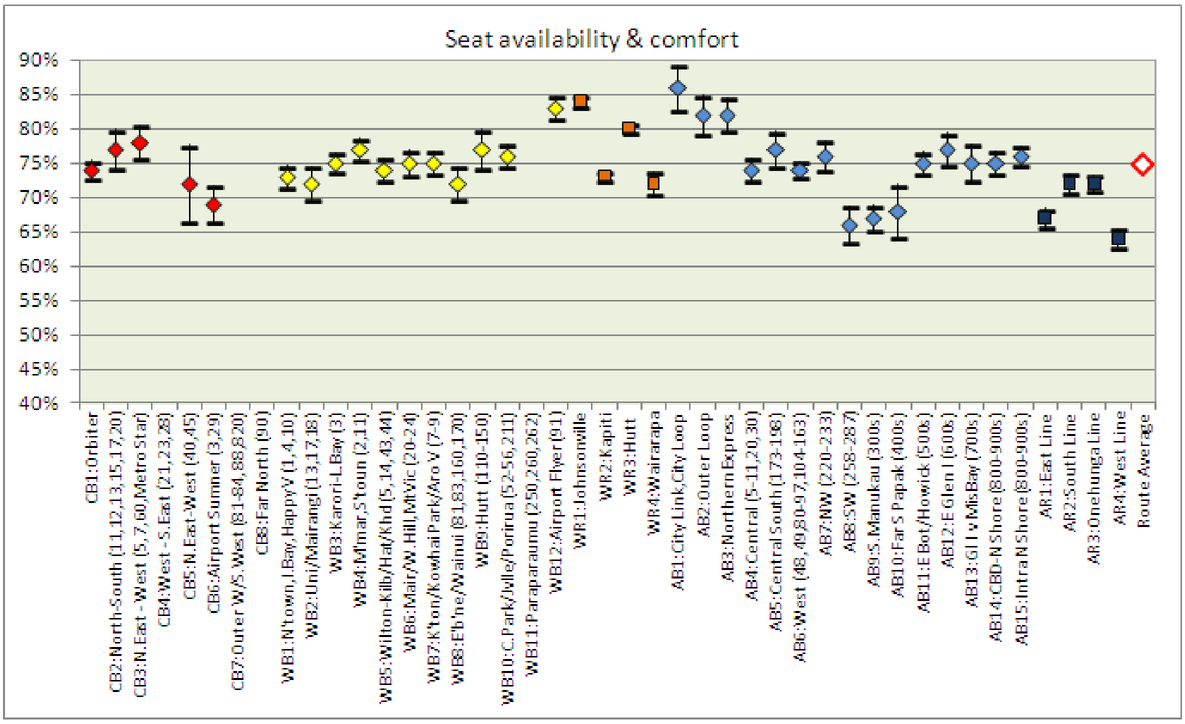
[20] Toilet availability and cleanliness is not graphed since the attribute was only included on the Wairarapa line service.

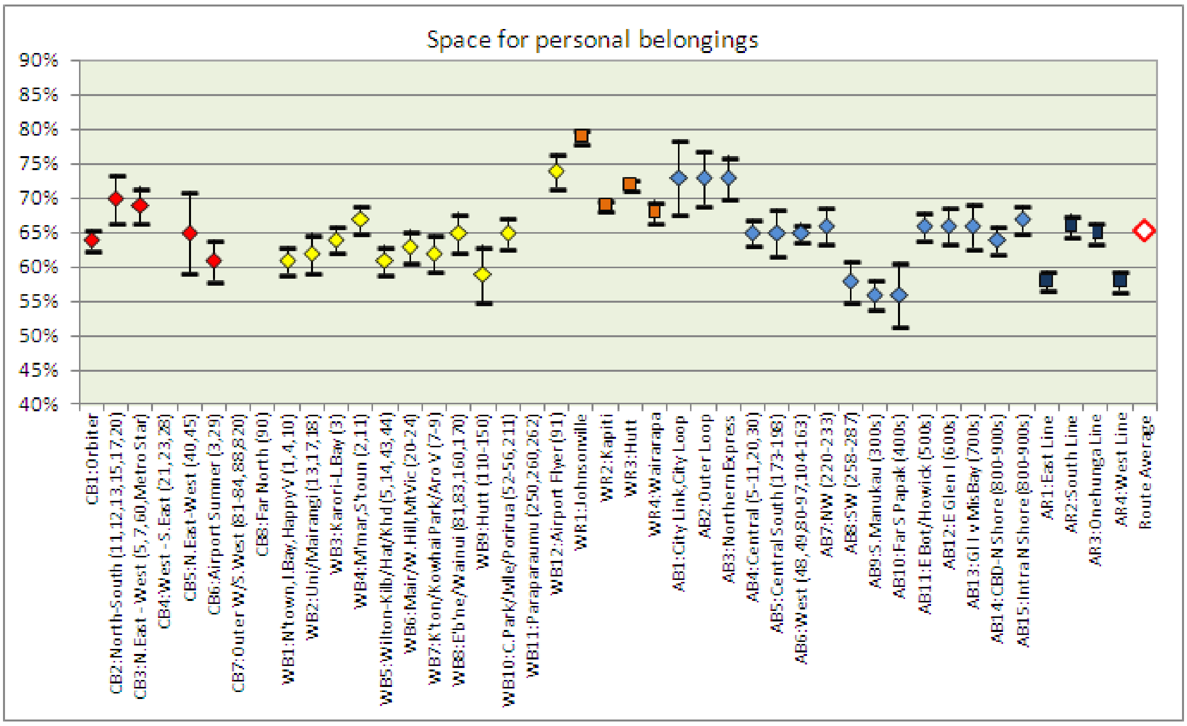
Figures 5.7a–b Bus and train attribute ratings by city



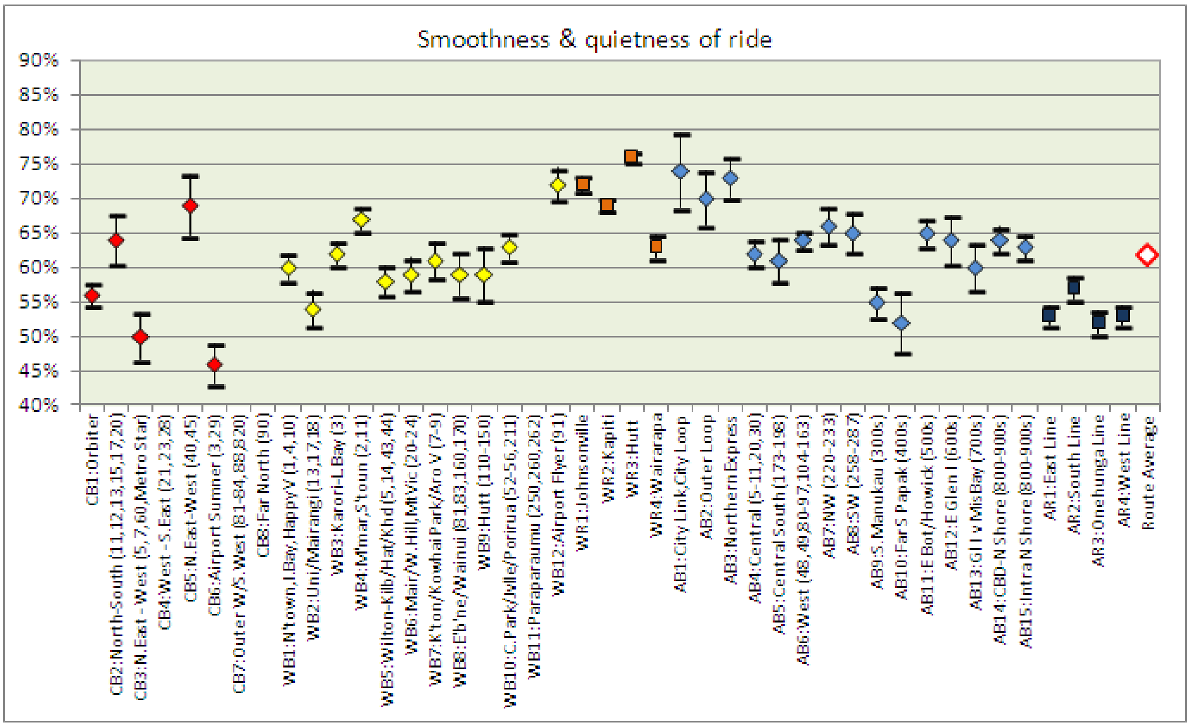


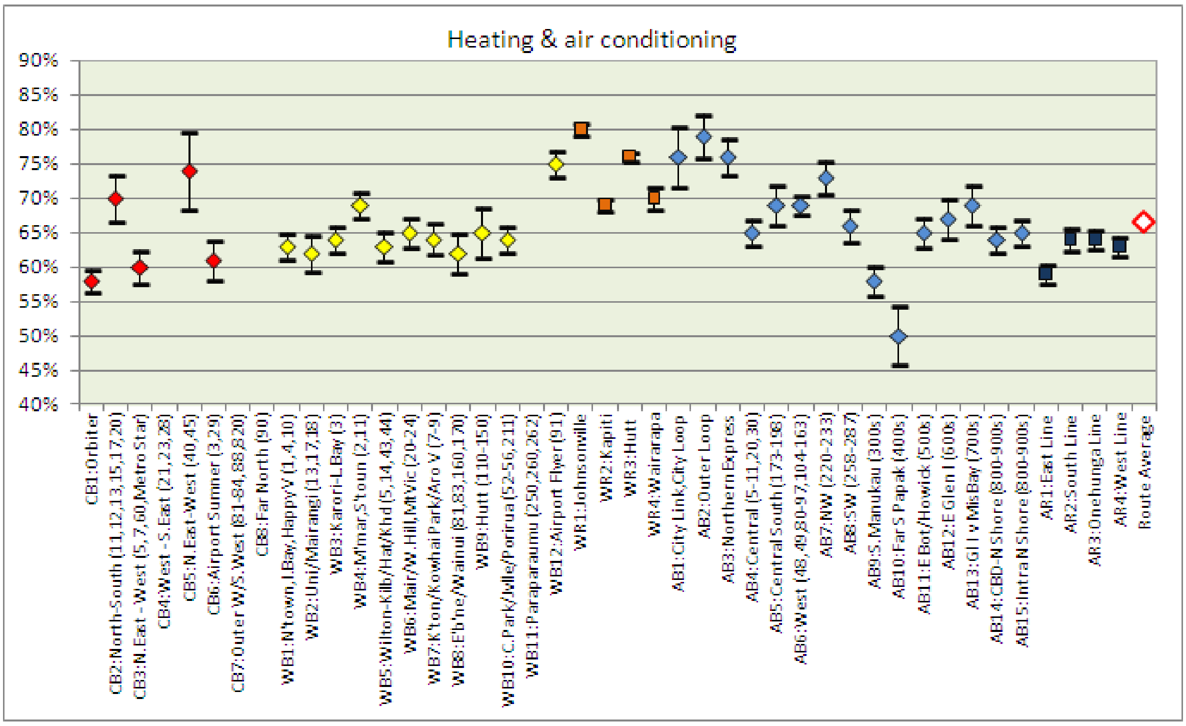
Figures 5.7c-d Bus and train attribute ratings by city



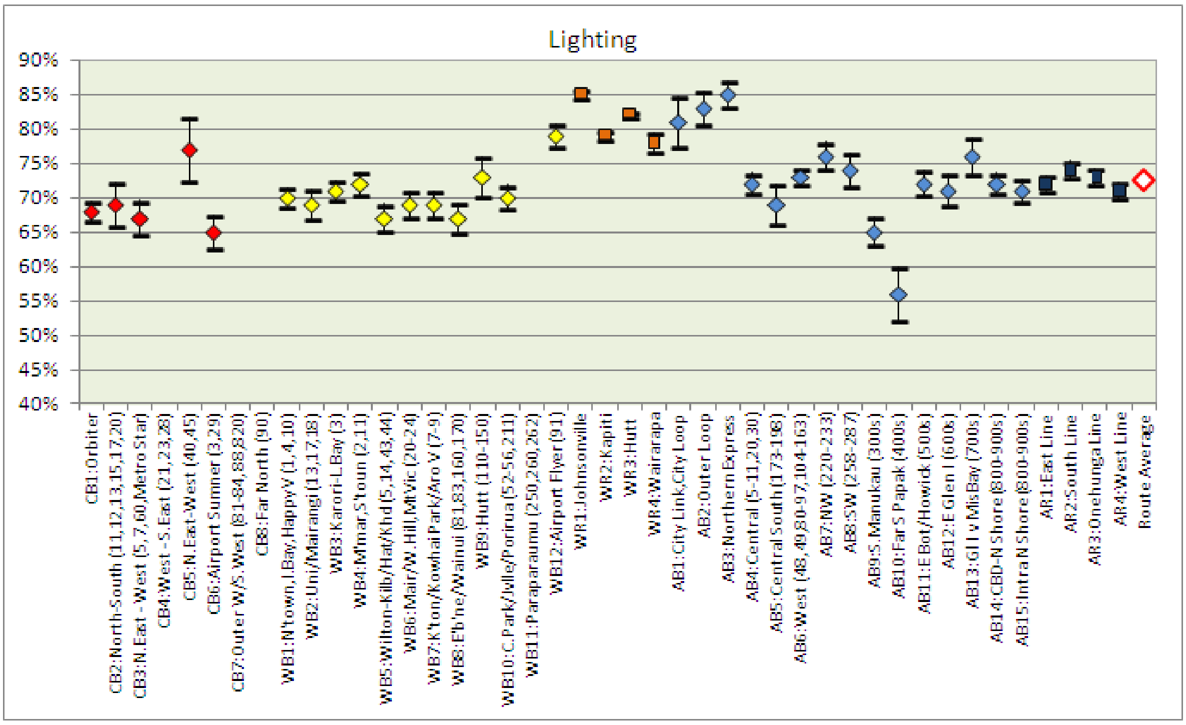


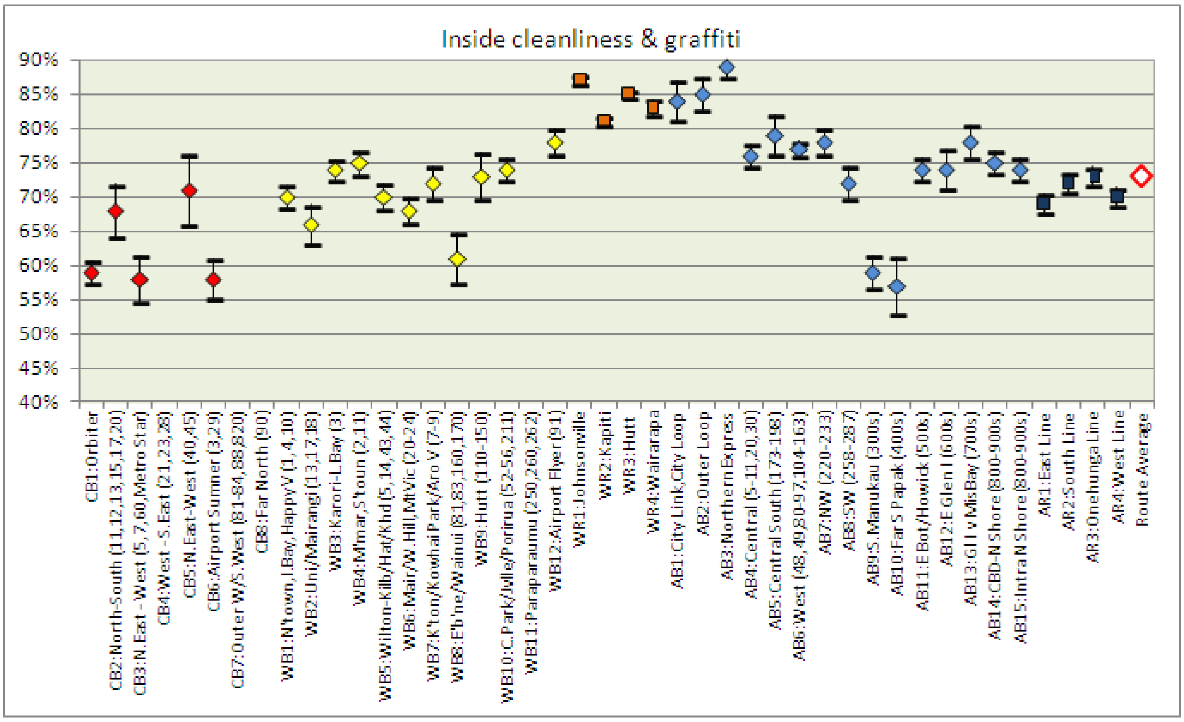
Figures 5.7e-f Bus and train attribute ratings by city



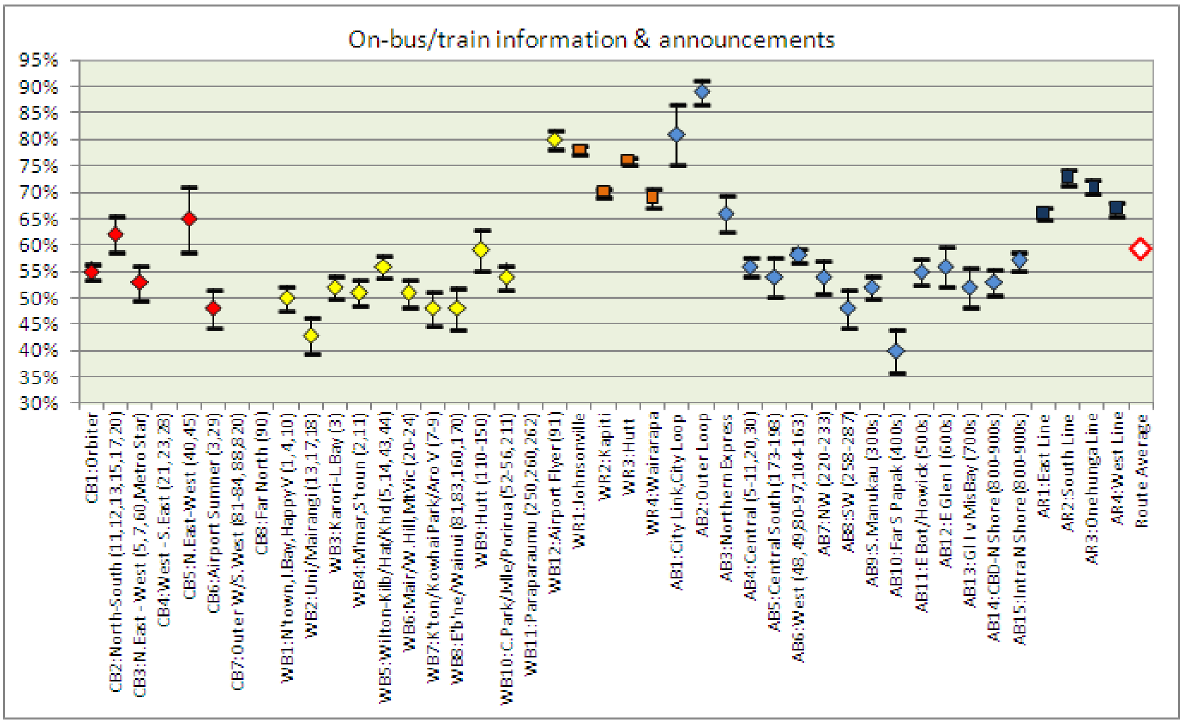


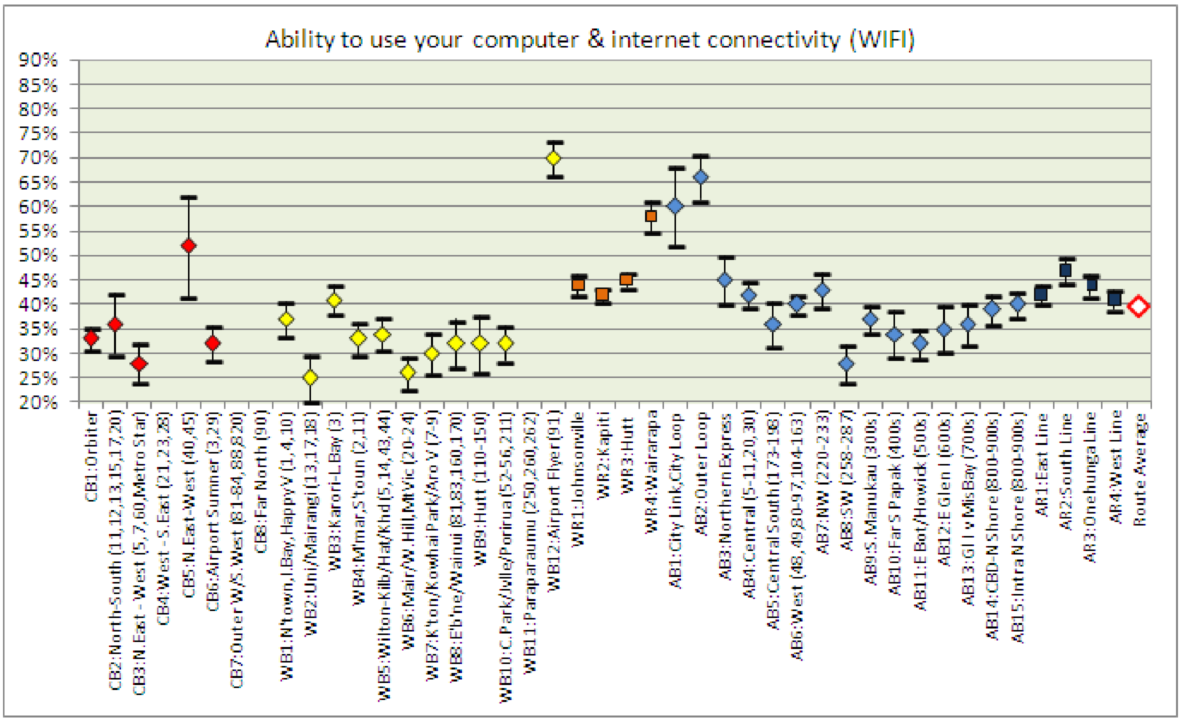
Figures 5.7g-h Bus and train attribute ratings by city



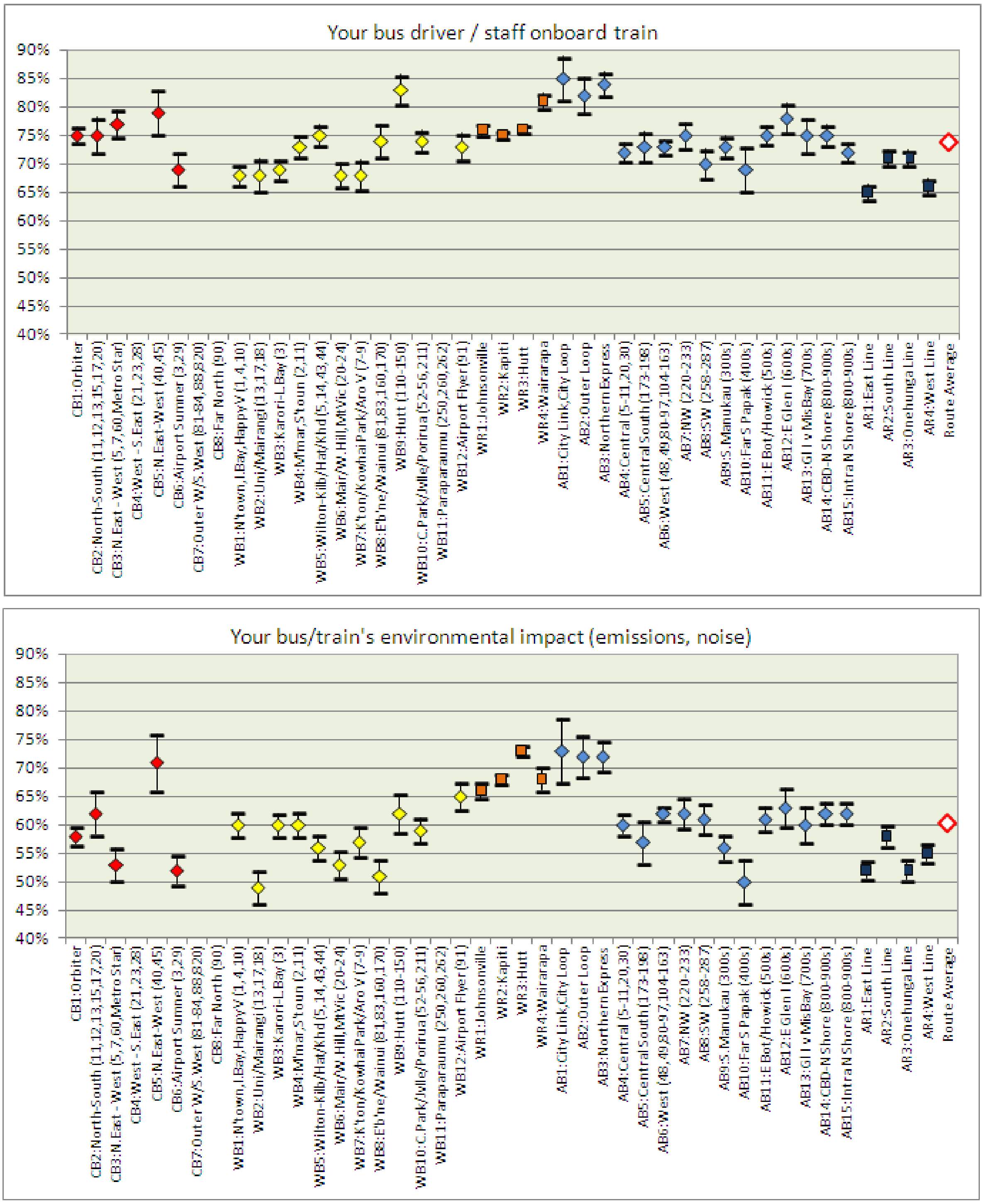


Figures 5.7i–j Bus and train attribute ratings by city





Figures 5.7k-l Bus and train attribute ratings by city



The greatest range in rating across the bus and train routes was for *onboard information and announcements*. The Auckland Outer Loop (AB2) was top with a rating of 89%. Rated bottom was the Far South Papakura route (AB10) which scored 40%. The range in rating was therefore 49%.

There was also a wide range in the *the ability to use your computer and internet connectivity*. Rated top at 70% was the Wellington Airport Flyer (WB12) which offers free wifi. Rated bottom was the Wellington University/Mairangi route which has a higher proportion of students and only scored 25%.

The narrowest range in rating (20%) was for *ease of getting on and off* and for *driver/staff*. The highest rated route was the Auckland City Link/Inner Loop route (AB1) which scored 85% to 86%. The lowest rated route for *getting on/off* was the Far South Papakura route (AB10) which scored 68% with the Auckland East (AR1) rail line rating lowest for *staff* (65%).

The rating of *comfort/quietness of ride* for the Christchurch bus routes reflected the effects on road conditions of the Canterbury earthquake. The worst rated route (46%) was the Airport-Sumner route (CB6) with the eastern Sumner end particularly badly affected. The highest rated route (70%) was the North East to West route (CB5) which was largely unaffected.

The correlation between the attribute ratings is presented in table 5.6. *Outside vehicle appearance* was strongly related to the *overall* rating with a correlation (r) of 0.86. In other words, a vehicle that scored highly in *outside appearance* also scored highly *overall*. The lowest correlation with the *overall* rating was for *driver/staff* (r=0.58) followed by *computer/internet* (r=0.66).

The strongest correlation between any pair of individual attributes was *lighting* and *heating/air conditioning* (r=0.9) and the lowest was between *computer/internet* and *ease of on/off* (r=0.35).

Table 5.6 Attribute rating correlation matrix

Attribute	OS	OnOf	Seat	Bag	SmQ	AC	Lght	C&G	Info	WIFI	Stff	Env	All
Outside Appearance	1	0.81	0.78	0.80	0.83	0.85	0.72	0.72	0.51	0.51	0.63	0.78	0.86
Ease of On & Off	0.81	1	0.89	0.79	0.71	0.72	0.66	0.62	0.46	0.35	0.65	0.66	0.78
Seat Av & Comfort	0.78	0.89	1	0.85	0.69	0.72	0.60	0.62	0.50	0.42	0.65	0.61	0.76
Space for Bags	0.80	0.79	0.85	1	0.71	0.81	0.75	0.67	0.67	0.56	0.57	0.67	0.84
Smooth & Quiet	0.83	0.71	0.69	0.71	1	0.85	0.79	0.81	0.54	0.54	0.57	0.89	0.79
Heating & Air Con	0.85	0.72	0.72	0.81	0.85	1	0.90	0.85	0.70	0.62	0.59	0.83	0.82
Lighting	0.72	0.66	0.60	0.75	0.79	0.90	1	0.88	0.78	0.66	0.56	0.83	0.81
Inside Clean & Graf	0.72	0.62	0.62	0.67	0.81	0.85	0.88	1	0.64	0.58	0.50	0.79	0.82
Info & Announce	0.51	0.46	0.50	0.67	0.54	0.70	0.78	0.64	1	0.84	0.47	0.66	0.73
Computer & Internet	0.51	0.35	0.42	0.56	0.54	0.62	0.66	0.58	0.84	1	0.43	0.66	0.66
Driver/Staff	0.63	0.65	0.65	0.57	0.57	0.59	0.56	0.50	0.47	0.43	1	0.73	0.58
Environ Impact	0.78	0.66	0.61	0.67	0.89	0.83	0.83	0.79	0.66	0.66	0.73	1	0.77
Overall Vehicle	0.86	0.78	0.76	0.84	0.79	0.82	0.81	0.82	0.73	0.66	0.58	0.77	1

5.6 Vehicle type, age and features

Surveyors were asked to write down the bus identification number, or for rail the type of car. AT, ECAN, GWRC and Mana Coaches provided 'objective' characteristic data to describe the individual buses such as age and seat capacity.

Nine characteristics were assessed as listed in table 5.7. Vehicle type (1) was the make and model of the bus or train. Vehicle age (2) was the age of the bus at the time of the survey. For rail, age was the number of years since the last major refurbishment for rolling stock other than the new Wellington Matangi.

The effect of seven other characteristics was assessed on the overall bus rating. The characteristics were 3) seat capacity; 4) the euro diesel engine rating with Wellington electric trolley buses denoted; 5) air conditioning, 6) whether the bus was a super floor; 7) whether the bus was wheelchair accessible; 8) whether a bicycle carrying rack was provided on the front of the bus although this characteristic only related to Christchurch buses and 9) whether the bus service was a considered to be a 'premium' service. As well as the effect on the overall vehicle rating, the effect on associated attributes was assessed. Thus, the effect of seat capacity was assessed on the *seat availability and comfort* rating. Table 5.8 lists the attributes assessed by characteristic.

Table 5.7 Bus and train characteristics

#	Data	Description	Mode
1	Vehicle type	Vehicle make and model	Bus and rail
2	Age of vehicle	Age of bus in years or last refurbishment (rail)	Bus and rail
3	Seat capacity	Number of seats on bus	Bus
4	Engine Euro rating	Euro rating of engine. Trolley buses distinguished	Bus
5	Air conditioning	Whether bus is air conditioned	Bus
6	Super low floor	Whether bus is super-low floored	Bus
7	Wheelchair accessible	Whether bus is wheel-chair accessible	Bus
8	Bike carry	Whether bus has a bike rack	Bus – CHC only
9	Premium bus route	Wellington Airport Flyer, Auckland Link and Loop Services & Northern Express	Bus

Table 5.8 Ratings assessed by vehicle characteristic

#	Classification	Attribute rating											
		OSAp	OnOff	Seat	Bags	SmQ	HtAC	Light	C/G	Info	Wifi	Env	All
1	Vehicle type	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
2	Age of vehicle	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
3	Seat capacity			✓									✓
4	Engine Euro rating											✓	✓
5	Air conditioning						✓						✓
6	Super low floor		✓										✓
7	Wheelchair accessible		✓										✓
8	Bike carry											✓	✓
9	Premium	✓								✓			✓

5.7 Summary of vehicle types

Table 5.9 lists the vehicles surveyed and describes their characteristics based on detail largely provided by AT, ECAN and GWRC. A total of 28 different bus types and seven different train types were covered by the survey.[21] Twelve MAN bus types were surveyed which averaged 2 to 15 years in age. In fact, MAN was the only type of bus that was surveyed where there was a noticeable range in age; all the other bus types tended to be of a similar age.

[21] The provision of onboard information such as next stop indicator boards or automatic announcements was not included but would be worthwhile assessing.

Table 5.9 Summary of vehicle types

#	Vehicle type		Vehicle details							Rating	
		M	Age years	Seats N	Bike rack CHC (%)*	Air con (%)	Super low floor (%)	WChair acc (%)	Euro engine	Overall rate %	Sample size
1	ADL	B	1.5	37	na	100%	100%	100%	5	75%	905
2	BCI	B	5	38	na	Na	na	na	3	79%	14
3	DLMacr	B	10	43	na	100%	100%	100%	3	75%	40
4	DLMerc	B	8	39	100%	0%	100%	100%	3	75%	28
5	MAN11	B	14.9	39	84%	0%	80%	60%	1	66%	1137
6	MAN12	B	9.9	41	100%	20%	100%	100%	3	69%	930
7	MAN13	B	5.2	32	na	100%	100%	100%	3	75%	15
8	MAN14	B	5.4	39	na	100%	100%	100%	3	69%	253
9	MAN15	B	5	41	na	100%	100%	100%	4	74%	9
10	MAN16	B	5.2	41	100%	30%	100%	100%	3	69%	306
11	MAN17	B	8.2	50	100%	50%	100%	100%	3	69%	1010
12	MAN18	B	2.6	43	100%	80%	100%	100%	4	71%	104
13	MAN1A	B	2.2	41	100%	100%	100%	100%	4	71%	255
14	MAN22	B	21	53	na	0%	0%	0%	Pre	60%	37
15	MANSG	B	30	76	na	0%	0%	0%	Pre	66%	11
16	MRC30	B	10.6	43	na	0%	0%	0%	1	67%	27
17	MRC709	B	16	25	na	0%	0%	0%	1	50%	6
18	NISSL	B	14	38	na	0%	100%	0%	Pre	60%	12
19	NISSS	B	16.4	38	na	0%	90%	40%	Pre	62%	47
20	OPTL	B	13	40	0%	0%	100%	100%	2	59%	35
21	OPTMR	B	18	22	na	0%	0%	0%	Pre	64%	70
22	OPTX	B	15	40	na	0%	100%	100%	2	58%	15
23	SCAN	B	3.7	47	100%	90%	100%	100%	4	74%	1054
24	TROLY	B	3	43	na	0%	100%	100%	T	73%	316
25	VOLB10	B	29	43	na	0%	0%	0%	1	37%	19
26	VOLB12	B	10	54	na	0%	0%	0%	3	81%	4
27	VOLB7	B	5.3	45	na	40%	100%	100%	4	72%	391
28	Zhong	B	2.9	39	100%	10%	100%	100%	4	62%	104
29	RA_ADK	R	11	68	na	100%	na	na	Diesel	67%	84
30	RA_ADL	R	11	68	na	100%	na	na	Diesel	66%	897
31	RA_SA	R	9	60	na	100%	na	na	Diesel	68%	481
32	RA_SD	R	9	60	na	100%	na	na	Diesel	69%	33
33	RW_DIE	R	5	64	na	100%	na	na	Diesel	78%	288
34	RW_GM	R	13	74	na	0%	na	na	Electric	59%	499
35	RW_MAT	R	1	75	na	100%	na	na	Electric	82%	2553

* Bicycle racks were only available on Christchurch buses with the percentage only calculated for CHC buses

Five bus types dominated the survey with each type surveyed over 900 times; they were the Alexander Dennis (ADL) the MAN11, MAN12, MAN17 and Scania. The MAN11 buses were the oldest averaging 15 years in service and scored an overall rating of 66%. The MAN12 and MAN17 were younger at 10 and 8 years respectively and both scored a 3% higher rating (66%) than the older MAN11. The Scania buses were younger, averaging four years in service and scored 74% overall. The Wellington Airport Flyer uses Scania buses that have next stop display and announced information, leather seats and bag storage facilities.

Figure 5.8 Bus types surveyed

The Auckland Outer Link is operated by Alexander Dennis (ADL) 37-seater buses less than two years old. Scored 75%.

The Scania 280D used on the Wellington Airport Flyer has 47 leather seats. The Scania bus type scored 74%.

The Wellington trolley bus (powered by overhead electricity) has 43 seats and is three years old. Scored 73%.

Volvo B7 used by Mana Coach services in Wellington has 45 seats and is five years old. Scored 72%

MAN 16.223 41 seater used by Redbus in Christchurch. Scored 69%.

Zhong Tong bus used in Christchurch has 39 seats and was less than three years old when surveyed. Scored 62%.

30-year-old articulated MAN SG220 with 76 seats surveyed on south Auckland routes. Scored 66%.

The 19-year-old Optare Metrorider has 22 seats. Scored 64% overall.

In terms of seat capacity, the buses ranged from a 22-seat, 19-year-old Optare Metrorider operated by Urban Express in Auckland to a 76-seat 30-year-old MANSG operated on South Auckland routes by NZ Bus.

The Volvo B7 is used by Mana Coaches on Johnsonville services in Wellington and scored 72%. The Zhong used in Christchurch scored 62% which was a low rating given it was less than three years old.

The Wellington trolley buses, built by Designline in Ashburton, are low floor with 43 seats and scored 73%.

The ADL buses were mostly surveyed on Auckland Link, Inner Loop and Outer Loop services. The ADLs were the youngest of the buses surveyed averaging 1.5 years in service. The ADLs are low floor with 43 seats and scored an overall rating of 75%. The routes scored highly with the Inner Loop/City Link scoring 79% and the Outer Loop 83% (overall ratings).

Figure 5.9 Alexander Dennis Ltd buses used on the Link services in Auckland

Most Christchurch buses have bike racks on the front. ECAN provided details on whether or not the buses surveyed had a bike rack. Bike racks were only installed on Christchurch buses, however, and the figures shown in table 5.9 therefore only refer to the percentage of Christchurch buses that had a bicycle rack.

Regional councils provided data on most of the buses surveyed that enabled them to be classified according to whether they were wheelchair accessible or not. Some buses were not classified however (the 'na's in table 5.9).

The Scania K270 shown below is a low floor bus and has a wheelchair sign on the front near the entrance door. It scored 74%.

Figure 5.10 Scania K270 used on Auckland Northern Express Services

Seven train types were surveyed. Four were Auckland diesel trains and three were Wellington trains. Although classified into four types, the Auckland trains can effectively be categorised into either loco-hauled suburban (SA) and suburban driving (SD) sets or diesel (ADL) and (ADK) rail cars.

The Auckland rail fleet has 15 SA carriages and five SD trailer carriages (shown in figure 5.11) that usually operate in six car units (5 SA + 1 SD). The carriages are coupled to a 1200hp diesel locomotive with the SD carriage enabling push/pull operation. The carriages are ex-British Rail and were refurbished in 2005/06 with new windows, battery equipment and air conditioning units, and recycled bogies. The rolling stock averaged nine years since refurbishment. The trains scored an overall rating of 68% to 69%.

The ADL/ADK rolling stock was built between 1982 and 1985 and operated for a decade in Perth before being imported to Auckland by NZ Rail in 1993.

The car interiors were refurbished and the exteriors repainted between 2002 and 2003 in an $8.5 million upgrade programme giving an average age of 11 years since last refurbishment. The ADL/ADK scored an overall rating of 66% to 67%.

Figure 5.11 Auckland rail fleet

Auckland SA/SD rolling stock scored 68% to 69% overall. (Wikipedia photo)

Auckland ADL/ADK rolling stock (Wikipedia photo)

The Wellington rail fleet comprises three train types: Matangis, Ganz Mavag and diesel loco-hauled carriages.

The Matangi cars, built in Korea, were introduced from 2011–12. The Johnsonville line was 100% operated by Matangi trains during the survey with all off-peak services on the Kapiti and Hutt Valley lines timetabled to be operated by Matangis.

The Matangis are 'paired' with a power car and trailer car. The cars have more seating running along the sides of the car compared with the Ganz Mavags to increase standing capacity (147 per two-car set) without reducing seating capacity (130). There is a low floor area for easier wheelchair access with the doors painted lime green (compared with navy blue on the other doors). The Matangis have next stop displays and recorded announcements. At 82%, the Matangis rated the highest of all the vehicles surveyed.

The Ganz Mavag electric multiple units operate in the peak on the Hutt Valley and Kapiti lines. The cars were built between 1979 and 1982 in Hungary and entered service between 1982 and 1983. A major refurbishment was undertaken in 1999–2003 by TranzRail giving an average age of 13 years since the last refurbishment. The Ganz Mavag scored the lowest train rating, averaging 59% over the 499 passengers surveyed.

Diesel-hauled carriages are used on the longer distance Wairarapa line. The carriages were ex British Rail Mark 2D and 2F stock that were rebuilt by Hillside Engineering and entered service on the Wairarapa line in Wellington from mid-2007. The average age since last refurbishment was five years.

The cars have next stop displays and recorded announcements. Seats have pull-down tables and there are some four-seater/table arrangements. There is power supply for computers and a key for wifi. Toilets are provided and there is a baggage car for bicycles. The carriages scored 78% overall.

Figure 5.12 Wellington rail fleet

The new Matangi rail cars (one year old when surveyed) scored the highest of any vehicle at 82% (Wikipedia photo)

The Ganz Mavag used in Wellington rated lowly averaging 59% (Wikipedia photo)

Diesel-hauled Wairarapa cars scored 78% (Wikipedia photo)

5.8 Vehicle type and attribute ratings

An analysis of the ratings of attributes was undertaken by vehicle type. For some vehicle types, the number of completed questionnaires was low. Thus in table 5.10, only the vehicle types which received a response from 10 or more passengers were included; this reduced the number of bus types to 28 and meant that the older bus types such as the articulated MANSG were not included.

The new Matangi trains were rated the top vehicle overall scoring highly in all the attributes. The Matangi came top in seven attributes and second in four more. Only in terms of staff, which is not a vehicle type related attribute, did the Matangi not come first or second (it came equal fifth).

The four Auckland train types rated similarly. The widest range in rating (9%) was for *cleanliness and graffiti* and for *information*.

The Ganz Mavag Wellington electric multiple units came last of the train types surveyed in 8 of the 12 attributes. For *outside appearance* at 49%, the units rated last of all the vehicles surveyed (trains and buses).

There was a 19-year range in the age of the bus types surveyed from the youngest bus type that had been in service for two years to the oldest with 21 years in service. The attribute ratings tended to decline as the age of the bus type increased, as measured by the negative correlations in table 5.11

The oldest bus type, the MAN22 at 21 years, surveyed on Karori and Wilton bus routes in Wellington, rated the lowest in 10 of the 13 attributes.

The second oldest bus type, the 18-year-old Optare Metrorider midi-bus with 22 seats rated lowest in two of the remaining categories (*seat availability/comfort* and *smoothness/quietness*).

Older buses were not always rated lower than new buses. The Designline Macrotech (DLMacr) which averaged 10 years in service on Western Auckland routes with Ritchie's routes, scored highly at 75%.

Table 5.10 Individual attribute ratings by vehicle type

#	Vehicle	M	Age	Rating (%)													Sample	
				OS	OnOff	Seat	Bag	SmQ	AC	Lght	C&G	Info	WIFI	Stff	Env	All	OS	All
1	ADL	B	1.5	76%	79%	77%	67%	77%	72%	75%	80%	60%	44%	74%	64%	75%	430	905
3	DLMacr	B	10	75%	82%	81%	75%	81%	63%	75%	75%	61%	29%	83%	69%	75%	27	40
4	DLMerc	B	8	77%	77%	78%	71%	78%	66%	67%	75%	58%	41%	71%	64%	75%	24	28
5	MAN11	B	14.9	67%	74%	71%	60%	71%	59%	65%	65%	50%	33%	72%	55%	66%	625	1137
6	MAN12	B	9.9	71%	77%	75%	65%	75%	64%	70%	69%	54%	36%	72%	60%	69%	468	930
8	MAN14	B	5.4	69%	75%	73%	62%	73%	55%	67%	58%	55%	33%	77%	58%	69%	181	253
10	MAN16	B	5.2	72%	75%	73%	66%	73%	67%	69%	66%	54%	29%	74%	56%	69%	114	306
11	MAN17	B	8.2	70%	75%	74%	62%	74%	66%	72%	73%	51%	37%	72%	58%	69%	487	1010
12	MAN18	B	2.6	68%	77%	74%	63%	74%	66%	68%	66%	49%	27%	73%	58%	71%	35	104
13	MAN1A	B	2.2	72%	82%	81%	73%	81%	70%	74%	65%	61%	36%	81%	65%	71%	64	255
14	MAN22	B	21	55%	55%	68%	55%	68%	44%	61%	61%	38%	12%	66%	44%	60%	17	37
19	NISSS	B	16.4	58%	72%	70%	59%	70%	57%	62%	65%	50%	28%	72%	55%	62%	29	47
21	OPTMR	B	18	66%	67%	61%	59%	61%	55%	64%	67%	54%	34%	67%	52%	64%	44	70
23	SCAN	B	3.7	76%	78%	78%	67%	78%	71%	76%	77%	62%	45%	75%	63%	74%	449	1054
24	TROLY	B	3	74%	79%	78%	69%	78%	69%	75%	77%	54%	38%	73%	65%	73%	194	316

#	Vehicle	M	Age	Rating (%)													Sample	
				OS	OnOff	Seat	Bag	SmQ	AC	Lght	C&G	Info	WIFI	Stff	Env	All	OS	All
27	VOLB7	B	5.3	77%	80%	76%	66%	76%	67%	74%	78%	58%	40%	76%	60%	72%	152	391
28	Zhong	B	2.9	70%	76%	78%	69%	78%	59%	70%	64%	51%	36%	75%	55%	62%	23	104
29	RA_ADK	R	11	62%	67%	72%	62%	72%	59%	73%	71%	64%	43%	66%	53%	67%	82	84
30	RA_ADL	R	11	62%	70%	68%	61%	68%	62%	71%	69%	68%	42%	67%	53%	66%	710	897
31	RA_SA	R	9	63%	70%	68%	63%	68%	63%	74%	73%	73%	44%	69%	56%	68%	354	481
32	RA_SD	R	9	63%	73%	69%	60%	69%	61%	73%	78%	68%	49%	67%	58%	69%	25	33
33	RW_DIE	R	5	78%	72%	72%	68%	72%	70%	78%	83%	69%	58%	81%	68%	78%	181	288
34	RW_GM	R	13	49%	71%	67%	65%	67%	51%	66%	65%	48%	30%	74%	53%	59%	317	499
35	RW_MAT	R	1	84%	84%	80%	74%	80%	78%	84%	87%	78%	46%	76%	72%	82%	1794	2553

Table 5.11 Correlation of vehicle attribute ratings

Vehicle Age/Rating Attribute	Veh Age	Attribute Ratings												
		OS	OnOff	Seat	Bag	SmQ	AC	Lght	C&G	Info	WIFI	Stff	Env	All
Age of vehicle	1	-0.72	-0.77	-0.73	-0.70	-0.73	-0.81	-0.72	-0.46	-0.43	-0.50	-0.56	-0.71	-0.69
Outside Appearance	-0.72	1	0.74	0.73	0.71	0.73	0.84	0.69	0.64	0.45	0.49	0.56	0.83	0.89
Ease of On & Off	-0.77	0.74	1	0.79	0.80	0.79	0.79	0.61	0.45	0.37	0.36	0.69	0.84	0.69
Seat Av & Comfort	-0.73	0.73	0.79	1	0.82	1.00	0.67	0.57	0.37	0.19	0.17	0.67	0.75	0.65
Space for Bags	-0.70	0.71	0.80	0.82	1	0.82	0.69	0.67	0.49	0.42	0.34	0.75	0.85	0.69
Smooth & Quiet	-0.73	0.73	0.79	1.00	0.82	1	0.67	0.57	0.37	0.19	0.17	0.67	0.75	0.65
Heating & Air Con	-0.81	0.84	0.79	0.67	0.69	0.67	1	0.82	0.74	0.62	0.64	0.46	0.84	0.87
Lighting	-0.72	0.69	0.61	0.57	0.67	0.57	0.82	1	0.82	0.80	0.73	0.44	0.78	0.80
Inside Clean & Graf	-0.46	0.64	0.45	0.37	0.49	0.37	0.74	0.82	1	0.70	0.74	0.20	0.72	0.79
Info & Announce	-0.43	0.45	0.37	0.19	0.42	0.19	0.62	0.80	0.70	1	0.82	0.14	0.57	0.64
Computer & Internet	-0.50	0.69	0.61	0.57	0.67	0.57	0.82	1.00	0.82	0.80	1	0.44	0.78	0.80
Driver/Staff	-0.56	0.56	0.69	0.67	0.75	0.67	0.46	0.44	0.20	0.14	0.13	1	0.72	0.52
Environmental Impact	-0.71	0.83	0.84	0.75	0.85	0.75	0.84	0.78	0.72	0.57	0.55	0.72	1	0.91
Overall Vehicle	-0.69	0.89	0.69	0.65	0.69	0.65	0.87	0.80	0.79	0.64	0.59	0.52	0.91	1

5.9 Vehicle type and age on passenger vehicle ratings

The passenger ratings showed a gradual decline with vehicle age. Figure 5.13 shows the downward trend, although for some estimates the sampling error was quite wide (reflecting the smaller sample size and/or a higher variability in rating)

The rating-age relationships for bus and rail were plotted separately. Both relationships were approximately linear. For a brand new bus, the predicted passenger rating was 75% and for a five-year-old bus, the rating was 3% lower at 72%. The rating then declined to 67% for a 10-year-old bus and 65% for a 15-year-old bus. Thus over 15 years, the rating declined by 10%. It should be stressed, however, that analysis does not track the same bus over a 15-year period (which would be a much more powerful form of analysis) but is instead a cross-sectional analysis that cuts across different bus types with different attributes (see table 5.9). The age-rating analysis did not separate out the features that were present in newer buses but not in older ones, such as air conditioning, super low floors, wheel chair accessibility and higher environmentally rated engines. Later in section 5.19, a regression analysis is presented that does attempt to separate out the age effect from other vehicle features.

For rail, the decline in rating with train age was more pronounced than for buses. Here it should be remembered that apart from the Matangis, the trains were rated on the number of years since last major refurbishment rather than since new.

The new Matangi trains scored 84% which compares with 75% for a new bus. The train rating then declined to 76% at five years and to 67% at 10 years since refurbishment. Thus after 10 years, the passenger ratings for a bus and a train were roughly the same.

The predicted ratings were based on a logistic regression shown in equation 5.4.[22] The logistic form constrained the rating to the 0% and 100% interval. Separate models were fitted for bus and rail with the observations weighted according to their sampling accuracy.[23] The estimated parameters are shown in table 5.12 and the predicted function is graphed in figure 5.13. A dotted line is used for trains older than 15 years to emphasise that it was an extrapolation (the figures in the table beneath the graph are shown in italics).

$$\ln\left[\frac{\Pr R}{1-\Pr R}\right]=\alpha+\beta_{age}AGE \quad \text{(Equation 5.4)}$$

Table 5.12 Overall vehicle rating with vehicle type and age

	Bus		Rail	
	α	βage	α	βage
Parameter	1.083	-0.031	1.633	-0.092
t value	12.2	2.5	79.2	27.8
Obs	28		7	

---

[22] David Hensher recommended a Tobit regression censored to the 0, 1 interval. For the bus observations, the coefficients were -0.008 for βage with a z value (se/coefficient) of 5 and 0.76 for α (z=36) with the Tobin sigma parameter equal to 0.066 with a z value of 7.5. However unlike most applications of a Tobit regression, there cannot be observations with ratings less than 0% or greater than 100%.

[23] The observations were weighed in accordance to their relative t values while maintaining the number of observations.

$$w_i=\frac{t_i}{\sum_j t_i} \text{ where } t_i=AvR\%_i \div\left[\frac{STE(AvR\%)_i}{\sqrt{N_i}}\right]$$

Figure 5.13 Overall vehicle rating with vehicle type and age

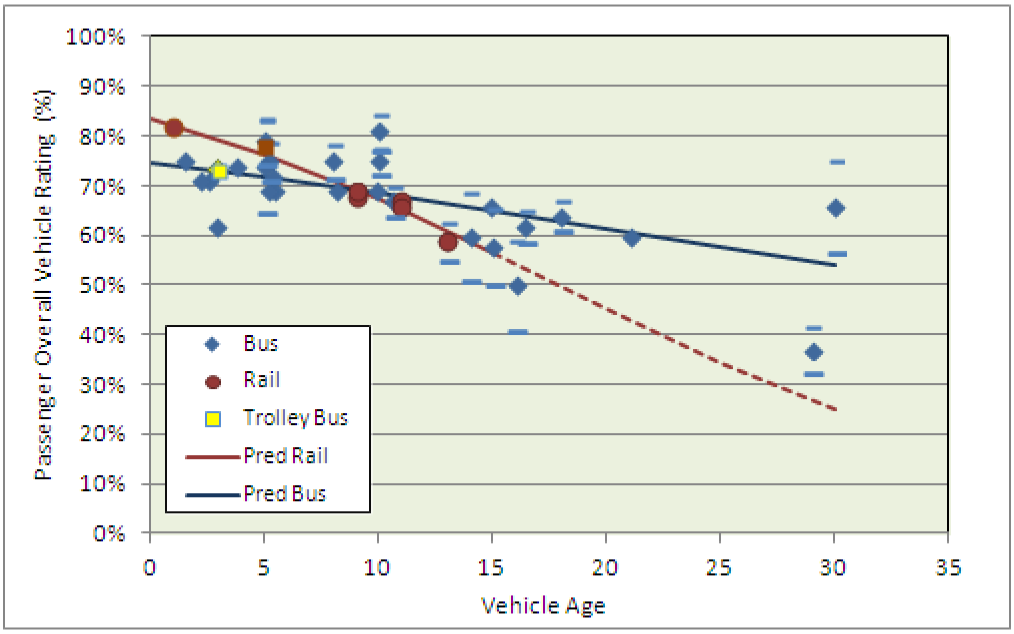
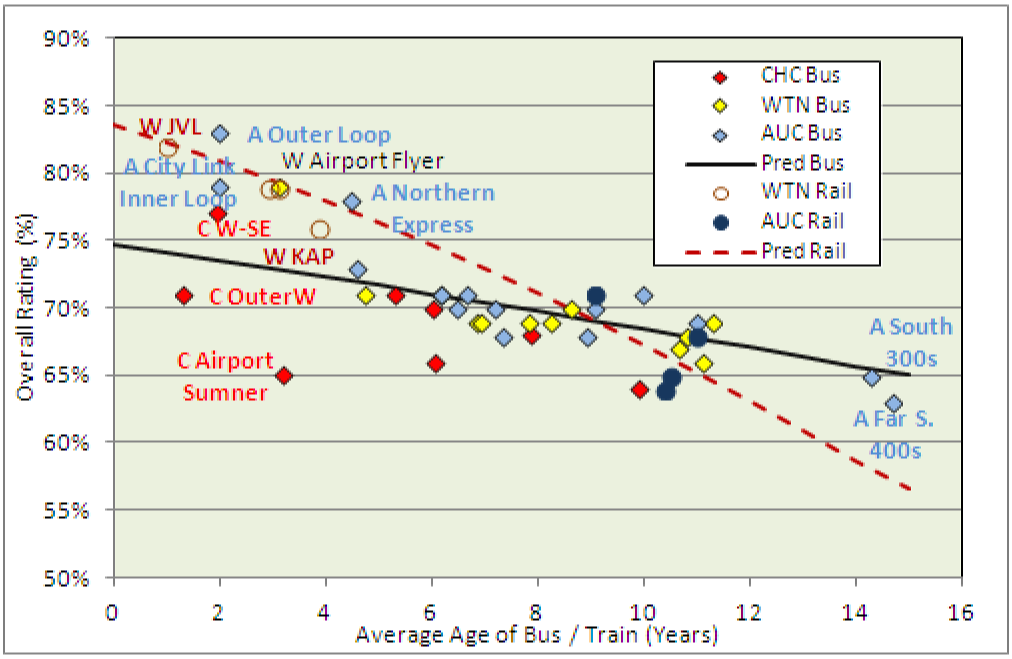


Table 5.13 Vehicle rating with age of vehicle

Age (years)	0	5	10	15	20	25	30
Rail rating %	84%	76%	67%	*57%*	*45%*	*34%*	*25%*
Bus rating %	75%	72%	68%	65%	61%	58%	54%

The same type of graph is shown for the aggregated routes in figure 5.14. For most of the bus routes, vehicle age was a good predictor of the overall rating. However for the 'branded' routes such as the Outer Loop in Auckland and the Airport Flyer in Wellington, the model under predicted. What pulled the relationship down were the two Christchurch routes where the buses were young but the passenger ratings were relatively low. For the Airport-Sumner route, the earthquake damaged roads probably contributed to the suppressed rating.

Figure 5.14 Vehicle rating and vehicle age by aggregated route



For rail, vehicle age accurately predicted the overall route rating. The Johnsonville line in Wellington which was fully operated by new Matangis achieved the highest rail rating of 84%. At the other end of the scale, the East and West rail lines in Auckland which were operated by diesel trains that had been refurbished a decade previously scored 65%.

By way of comparison, the Gravitas customer satisfaction (see section 2.4) categorised buses into 'new', 'old' and 'not known' which enabled the attribute ratings to be analysed by age group. New buses achieved an overall rating of 75% which was 5% points higher than old buses (70%). The higher rating was consistent across the individual attributes except for seating where both new and old achieved the same rating. The average overall rating was 75% which compares with 71% estimated for Auckland buses (table 5.2).

Table 5.14 Bus rating with age of bus – Gravitas Auckland questionnaire

	Clean	Comfort	Seats	Board	Graffiti	Pollution	Alight	Overall	Sample
New	75%	73%	75%	79%	78%	73%	79%	76%	2,423
Old	70%	67%	75%	76%	74%	67%	74%	71%	292
NK	76%	75%	75%	81%	83%	75%	80%	78%	195
All	74%	73%	74%	78%	67%	77%	78%	75%	2,910

Note: NK = not known

A similar analysis of the Gravitas data for rail was not possible because all the trains were of a similar age. At 74%, the overall train rating estimated from the Gravitas data was higher than the 67% estimates in the pricing strategies (table 5.4). The individual Gravitas attribute ratings for rail ranged from 68% for cleaning (both for the train interior and exterior) to 79% for ease of boarding/alighting.

5.10 Bus seat capacity and passenger ratings

The effect of seat capacity on the *seat availability/comfort* rating and also on the *overall* rating was assessed but only for buses. Trains were not modelled because there was little difference in the seating capacity of the different train types.

Table 5.15 and figure 5.15 present the average ratings, sample sizes and also the average bus age by seat capacity. The scattergram shows the number of seats to increase the rating and for age to shift the 'seat' curves downwards. The vehicle size relationship was most evident for the 10–20 age category of bus (blue triangles). The two 'over 20 years old' observations (brown diamonds) also increased with bus size.

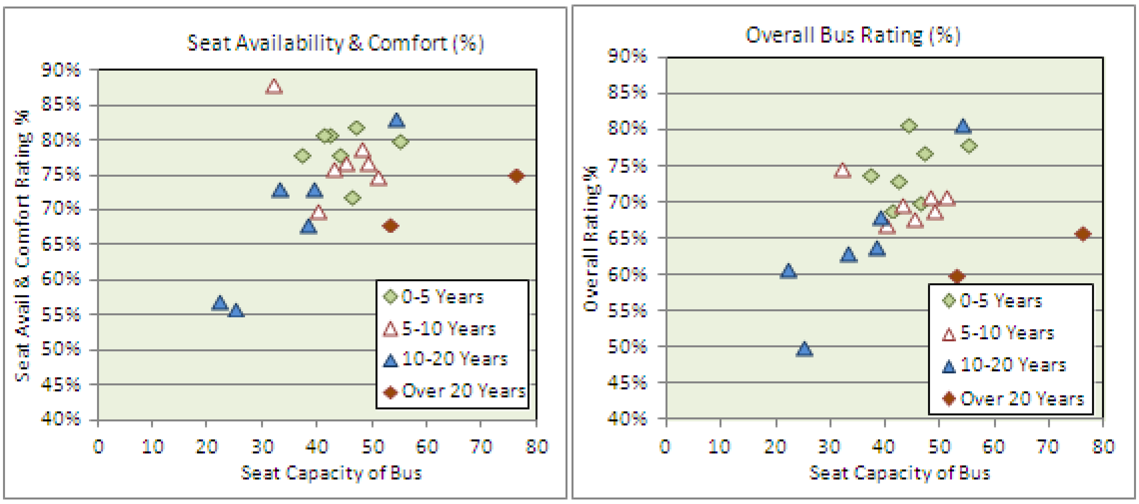
In terms of age, buses under five years old (shown as green diamonds) had the highest ratings and were therefore clustered at the top of the graph. Five to ten-year-old buses (shown as red outlined triangles) were the second highest. The lowest ratings were for the two smaller 'midi buses' with capacities of 22 and 25 seats and ages of 18 and 16 years respectively although the sample size for the Mercedes 709 midi-bus used on the Hutt Valley services was small.

For seat availability/comfort, the midi-buses rated at just below 60% with the Mercedes 709 services scoring a lower overall rating of 50% (sample of six) compared with a rating of 61% for the Optare Metrorider (sample of 36). The largest bus was the 76-seater MANSG220 used on South Auckland routes which scored 75% in seat availability and comfort which was relatively high given its 30-year age. By contrast the other over 20-year-old bus was the MAN22.

Table 5.15 Bus ratings with seat capacity

Obs	Seat capacity	Veh age years	Seat av and comfort			Overall rating		
			Rating %	STE	Sample	Rating %	STE	Sample
1	22	18	57%	30%	30	61%	24%	36
2	25	16	56%	27%	2	50%	22%	6
3	32	5.1	88%	14%	7	75%	15%	15
4	33	11	73%	22%	27	63%	21%	31
5	37	2.1	78%	20%	498	74%	19%	1115
6	38	13.8	68%	25%	37	64%	24%	70
7	39	10.7	73%	22%	1220	68%	21%	2292
8	40	6	70%	21%	112	67%	20%	346
9	41	3.5	81%	19%	52	69%	21%	107
10	42	3	81%	19%	44	73%	19%	108
11	43	7.6	76%	19%	353	70%	19%	662
12	44	4	78%	21%	4	81%	15%	12
13	45	6.8	77%	21%	25	68%	19%	92
14	46	4.6	72%	22%	168	70%	20%	333
15	47	3.6	82%	16%	112	77%	19%	362
16	48	6	79%	14%	3	71%	21%	24
17	49	5.1	77%	17%	42	69%	20%	138
18	51	8	75%	20%	625	71%	19%	1312
19	53	21	68%	19%	17	60%	15%	37
20	54	10	83%	19%	5	81%	7%	4
21	55	3	80%	22%	24	78%	17%	42
22	76	30	75%	25%	3	66%	30%	11

Figure 5.15 Bus ratings with seat capacity and bus age



A logistic model with seat age and seat capacity included as explanatory variables was fitted to explain the passenger ratings.[24] The estimated parameters are presented in table 5.16 and the predicted ratings graphed in figure 5.16. The seat capacity parameter was positive and was similar in size for both the *seat availability/comfort* and *overall* rating models. What differed was the constant positioning parameter which was a third lower in the *overall* rating model.

$$\ln\left[\frac{\Pr R}{1-\Pr R}\right] = \alpha + \beta_{age} AGE + \beta_{seats} SEATS$$ (Equation 5.5)

Table 5.16 Bus ratings and seat capacity model

	Seat availability/comfort rating			Overall rating		
	βage	βseats	α	βage	βseats	α
Parameter	-0.038	0.009	1.048	-0.034	0.010	0.680
|t| value	3.6	1.3	3.5	4.6	2.2	3.3
Nobs	22			22		

[24] Weighting reduced the significance of the parameter for the seat capacity because some 'pivotal' observations had low sample sizes. For the seat availability and comfort rating model, the t value for the seat parameter was 3.2.

Figure 5.16 Predicted bus ratings with seat capacity and bus age

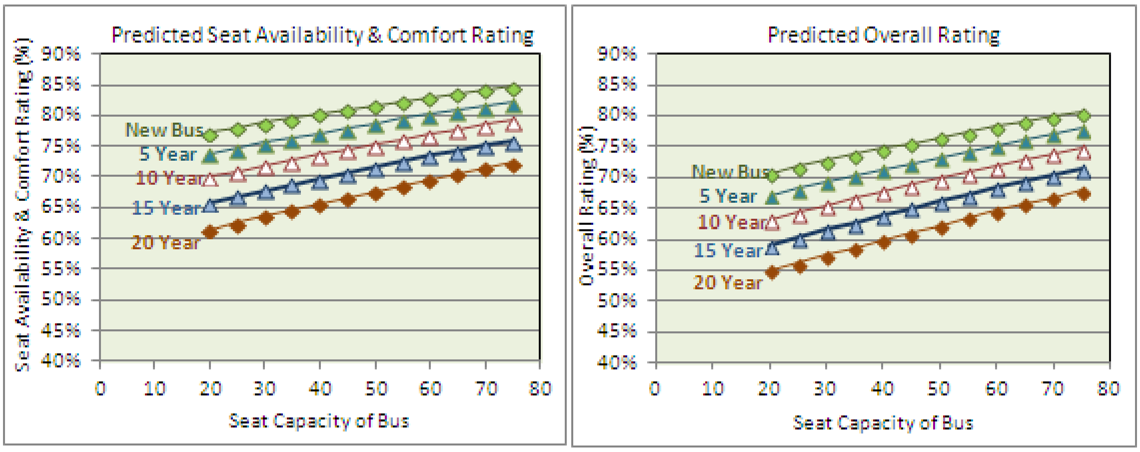


Table 5.17 Predicted bus ratings with seat capacity and bus age

Seats	Seat availability and comfort rating					Overall bus rating				
	Age of bus (years)					Age of bus (years)				
	0	5	10	15	20	0	5	10	15	20
20	74%	70%	66%	61%	57%	69%	65%	60%	56%	52%
25	76%	72%	68%	64%	59%	70%	66%	62%	58%	54%
30	77%	74%	70%	66%	61%	72%	68%	64%	60%	56%
35	79%	76%	72%	68%	63%	74%	70%	66%	62%	58%
40	80%	77%	74%	70%	65%	75%	72%	68%	64%	60%
45	82%	79%	75%	72%	67%	77%	73%	70%	66%	62%
50	83%	80%	77%	73%	69%	78%	75%	71%	67%	63%
55	84%	82%	79%	75%	71%	79%	76%	73%	69%	65%
60	86%	83%	80%	77%	73%	81%	78%	74%	71%	67%
65	87%	84%	81%	78%	75%	82%	79%	76%	72%	69%
70	88%	85%	83%	80%	77%	83%	80%	77%	74%	70%
75	89%	86%	84%	81%	78%	84%	82%	79%	76%	72%

A new bus with 20 seats was predicted to have a *seat availability and comfort* rating of 74% and an *overall* rating of 69%. Doubling the number of seats to 40 increased the ratings to 80% and 75% and tripling the seats to 60 achieved ratings of 86% and 81% respectively.

For a 40-seat bus, the effect of ageing from new to 10 years reduced the *seat availability and comfort* rating from 80% to 74%. Ageing the same 40-seat bus by 20 years reduced the rating to 65%. Thus the *seat availability and comfort* rating declined by 15% points over the 20-year life of the bus. The same reduction was predicted for the *overall* rating (75% to 60%) but from a lower initial rating.

5.11 Euro engine bus rating

European emission standards define the acceptable limits for exhaust emissions for new buses sold in European Union member states. The emission standards are defined in a series of European Union directives staging the progressive introduction of the standards. The emission standards cover carbon monoxide (CO), hydrocarbons (HC), nitrogen oxides (NOx), particulate matter (PM) and smoke and since 1992 there have been five Euro ratings.[25]

The regional authorities provided details to classify buses into either 'pre-rating' or one of five Euro standards. Wellington trolley buses were denoted as 'trolley'. Table 5.18 and figure 5.17 present the environmental and overall ratings with the Euro engine average age also given.

Table 5.18 Bus ratings with Euro engine rating

Euro engine rating	Av age years	Environmental rating		Overall rating (%)		Sample size
		Average	Age predicted	Average	Age predicted	
Pre-rating	16	54%	54%	64%	64%	264
1	15	55%	55%	65%	65%	1,081
2	12	58%	57%	67%	67%	467
3	8	59%	60%	69%	70%	2,107
4	4	61%	63%	71%	72%	1,552
5	2	64%	64%	75%	74%	1,368
Trolley	3	65%	63%	73%	73%	316

The age–Euro engine relationship is necessarily inverse with the 'pre-rating' buses the oldest averaging 16 years, followed by Euro 1 buses at 15.[26] Bus age then decreased to an average of two years for a Euro 5 bus.

Figure 5.17 shows the environmental and overall ratings to increase with the Euro engine rating. The Wellington trolley bus is also shown which had the highest environmental rating of 65%, 1% higher than the Euro 5 bus. The lowest environmental rating was 54% for 'pre-rating' buses. The range from high to low was therefore 11%.

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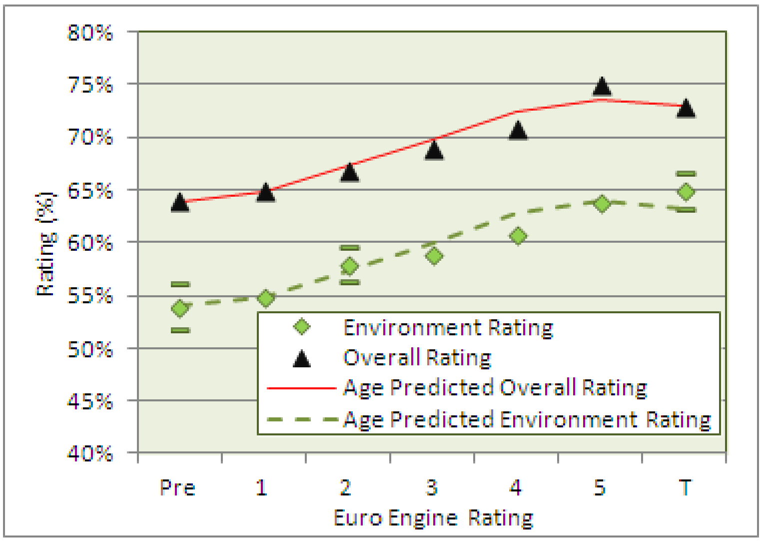
[25] For buses the engine standards related to heavy-duty diesel engines which are defined by engine energy output (g/kWh). Dates in the tables refer to new type approvals; the dates for all type approvals are in most cases one year later (EU type approvals are valid longer than one year).

Euro	Date	EU emission standards for HD diesel engines, g/kWh (smoke in m−1)				
		CO	HC	Nox	PM	Smoke*
1	1992 <85kW	4.5	1.1	8	0.612	
	1992 >85kW	4.5	1.1	8	0.36	
2	Oct 1996	4	1.1	7	0.25	
	Oct 1998	4	1.1	7	0.15	
3	Oct 2000	2.1	0.66	5	0.1	0.8
4	Oct 2005	1.5	0.46	3.5	0.02	0.5
5	Oct 2008	1.5	0.46	2	0.01	0.5

Source: Wikipedia

[26] The average age of the 'pre-Euro rating' bus was 16 years which is less than the 21 years implied by the first year Euro 1 buses were introduced.

Figure 5.17 Predicted bus ratings with Euro engine rating



The overall rating followed a similar trend but with the curve positioned higher. The passenger rating ranging increased from 64% for 'pre-rated Euro' bus to 74% for a Euro 5 bus. The trolley rated 2% lower at 73%.

With such a close relationship between engine rating and vehicle age, determining the individual effect of engine rating on the passenger ratings was not possible. Indeed, using the bus age model (table 5.12) gave a predicted overall bus rating that was nearly identical to the Euro rating mean scores. The only difference was an under-prediction of the trolley bus *environmental* rating suggesting respondents may have taken account of the zero exhaust emissions and quietness of the electrically powered trolley bus.[27] The advantage was not marked, however, at only 2% (65% versus 63%).[28]

5.12 Air conditioning and bus rating

Passengers rated air-conditioned buses higher than non air-conditioned buses both in terms of the *heating/air conditioning* rating but also in terms of the *overall* rating.

Air-conditioned buses scored 68% in *heating/air-conditioning* compared with 63% for non air-conditioned buses.

The *overall* ratings were higher at 72% and 68% respectively. Again, however, air-conditioned buses tended to be newer. Indeed, vehicle age predicted the overall rating exactly.

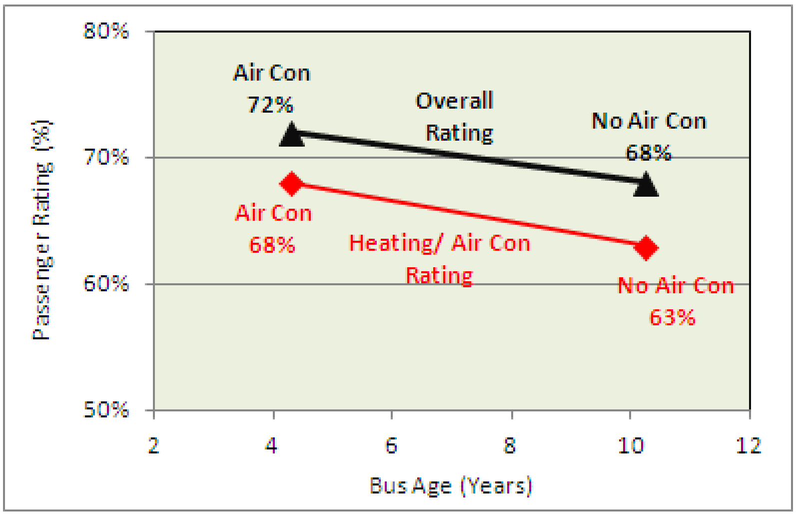
Table 5.19 Bus ratings with air conditioning

Bus type	Age years	Rating (%)		Std dev (%)		Sample size	
		Heat/air conditioning	Overall	Heat/air conditioning	Overall	Heat/air conditioning	Overall
Air conditioning	10.2	63%	68%	24%	20%	1,802	3,701
No air conditioning	4.3	68%	72%	24%	20%	1,569	3,440
Total	7.4	65%	70%	24%	20%	3,371	7,141

[27] A similar model to equation 5.4 was fitted to the average age and environmental ratings in table 5.18. The estimated parameters were $\alpha = 0.625$ ($|t| = 17.2$) and $\beta = -0.028$ ($|t| = 7.9$).

[28] The predicted rating was equal to the lower standard error range in the observed estimate.

Figure 5.18 Bus ratings with air conditioning



5.13 Low floor and bus rating

Low floor buses have no door steps making them easier to get on and off especially for the elderly, infirm, passengers in wheelchairs and passengers with strollers/heavy luggage etc.

The buses were not able to be distinguished into those that 'kneel' at stops making the bus level with the curb and those buses that have no raised rear part of the bus.[29]

Non low floor buses were older (averaging 18 years) and had either one or two steps at the front door.

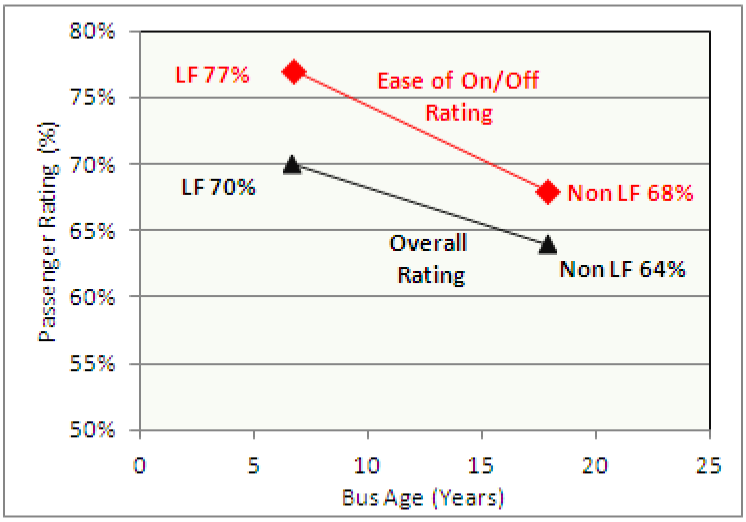
As table 5.20 shows, most buses were classified as low floor. Indeed, ECAN classified all its buses as 'super low floor'. Thus the 4% of respondents who were surveyed on non-low-floor buses were in Auckland or Wellington. There was a stronger relationship for the *on/off* rating than for the *overall* rating which is reflected in the steeper curve shown in figure 5.19. *Ease of getting on and off* buses with low floors was rated at 77% compared with 68% for non low-floor buses. The range in rating was therefore 9% compared with 6% in the *overall* rating.

Table 5.20 Bus ratings with low floor

Bus type	Age years	Rating (%)		Std dev (%)		Sample size	
		On off	Overall	On off	Overall	On off	Overall
Low floor	6.7	77%	70%	19%	20%	3,205	6,701
Non-low floor	17.8	68%	64%	24%	23%	212	440
Total	7.4	76%	70%	20%	20%	3,417	7,141

[29] Buses were categorised as 'super low floor' or not but the term 'super' has been omitted. Further work could discriminate according to whether the low-floor bus could 'kneel', whether the buses have only one level, and, for non low-floor buses, whether there were one or two steps.

Figure 5.19 Bus ratings with low floor



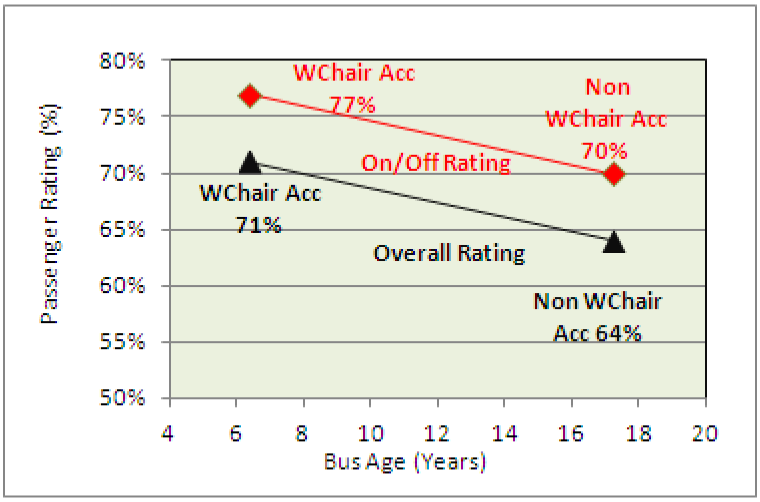
5.14 Wheelchair accessible and bus rating

Nearly all the low floor buses surveyed were also classified as wheelchair accessible by the regional authorities.[30] As a consequence, both the *ease of on/off* and the *overall* rating were close to the low floor estimates.

Table 5.21 Bus ratings with wheelchair accessibility

Bus type	Age years	Rating (%)		Std dev (%)		Sample size	
		On off	Overall	On off	Overall	On off	Overall
Wheelchair accessible	6.4	77%	71%	19%	20%	3,071	6,472
Non-wheelchair accessible	17.2	70%	64%	23%	22%	346	669
Total	7.4	76%	70%	20%	20%	3,417	7,141

Figure 5.20 Bus ratings with wheelchair accessibility



[30] This can be seen by comparing the sample sizes in table 5.21 with table 5.20.

5.15 Bicycle racks and Christchurch bus rating

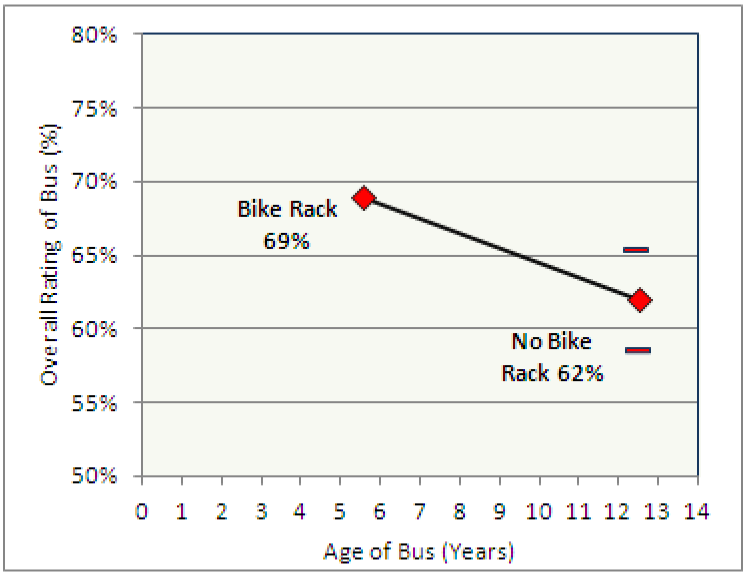
Bicycle racks are only installed on Christchurch buses. All but 47 (4%) of the passengers surveyed in Christchurch were travelling on buses with racks fitted on the front to carry bicycles.[31] These buses tended to be younger with an average age of 5.5 years than non-bicycle rack buses which averaged 12.5 years.

The overall rating for buses with bicycle racks was 69%, 7% higher than for buses without bicycle racks (62%). Again, however, the association of bicycle racks with younger buses needs to be taken into account.

Table 5.22 Christchurch overall bus rating with/without bicycle racks

Bicycle rack	Vehicle age years	Overall rating		
		Average (%)	Std dev	Sample
Bicycle rack	5.5	69%	20%	1,244
No bicycle rack	12.5	62%	23%	47
Total	5.8	68%	21%	1,291

Figure 5.21 Christchurch overall bus rating with/without bicycle racks



5.16 Premium bus routes

The Wellington Airport Flyer; the Auckland Link, Inner and Outer Loop services; and the Auckland Northern Express were highly rated. All use newer buses in branded livery and generally provide a 'premium' standard of service that includes onboard information and announcements.

Table 5.23 and figure 5.22 show the higher ratings that the premium services achieved in terms of the *outside appearance, onboard information* and *overall* ratings.

[31] 25 out of 33 buses that were surveyed were fitted with bicycle racks. Some buses were surveyed more than once.

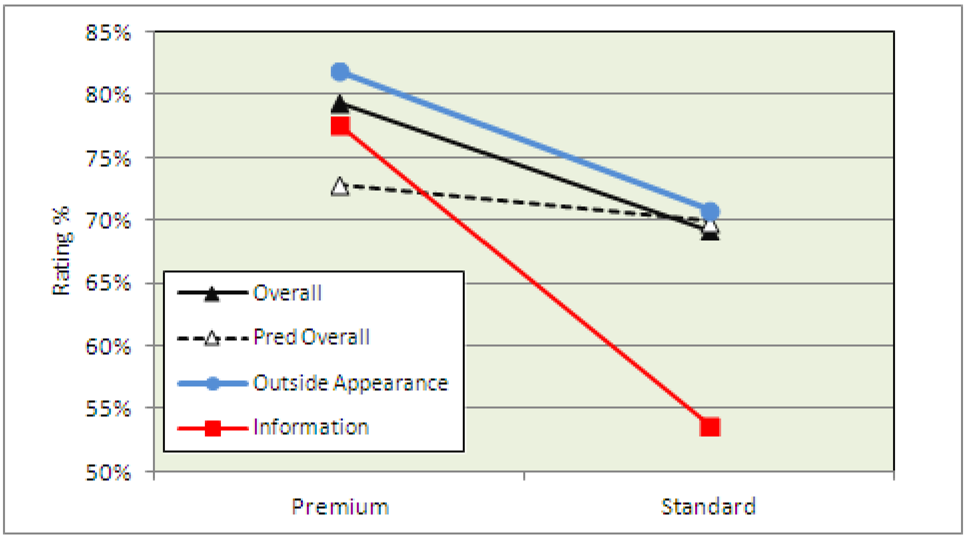
Outside appearance rated at 82% compared with 71% for standard buses. Even more pronounced was the rating of *onboard information and announcements* which scored 78% for the premium routes compared with 54% for standard bus services.

The *overall* rating was 79% compared with 69% for standard buses. The rating was also 6% higher than predicted purely on the basis of bus age (3.1 years compared with 7.7 years).

Table 5.23 Attribute rating for premium versus standard bus services

Bus route	Vehicle age years	Overall rating		Attribute rating		Sample size		
		Average (%)	Pred age	OS app	Info	Overall	OS app	Info
Premium	3.1	79%	73%	82%	78%	599	217	212
Standard	7.7	69%	70%	71%	54%	6,556	3,203	3,174
All	7.4	70%	70%	71%	55%	7,155	3,420	2,962

Figure 5.22 Attribute rating for premium versus standard bus services



5.17 Vehicle attribute models based on individual response

The vehicle models presented in sections 5.9 to 5.16 were reestimated using the individual response data which for the overall vehicle rating provided 11,990 observations.

The ultimate aim was to produce an overall model that combined the vehicle data with the respondent profile information (see section 5.18). The modelling also provided the statistical significance for the differences in rating.

Linear and logit models were fitted. The linear model had the advantage that the parameters were easily interpreted as percentage ratings. By contrast, the logistic models need transformation but have the advantage of being constrained to the 0% and 100% interval.[32] Given the functional form, the logistic

[32] The transformation is $P(R\%) = \dfrac{\exp(\alpha + \sum \beta X)}{1 + \exp(\alpha + \sum \beta X)}$

parameters were typically five times larger for the explanatory anvariables and 1.5 times larger for the constant parameter.[33] The logistic models were estimated using NLOGIT5. Robust estimation was used for the logistic model to correct for the non-constant error variance (that would otherwise have inflated the standard errors and reduced the parameter |t| values).[34]

Table 5.24 presents the 'overall rating' models. The first eight models effectively estimate the aggregate models presented in sections 5.9 to 5.16. The ninth model presents a 'full model' that combines all the statistically significant variables.

The discussion refers to the linear parameters and for the most part, the estimates and conclusions are the same as those made in the preceding sections. The t value measures the statistical significance of the estimated parameters. Adopting the conventional threshold value of 1.96 meant that only one variable in the linear model and two in the logit model (all in the Euro engine model) were not significant.

Model 1 presents the 'average' overall vehicle ratings for bus and rail by city. By specification, the 'constant' gives the rating for Christchurch bus which is 68% (linear model). Wellington rail (WTN) increases the rating to 78% whereas Auckland rail (AUC) reduces the rating by 1% to 67%. Wellington bus (WTNBus) subtracts 8% whereas Auckland bus (AUCBus) adds 4% to Auckland rail to produce the same 70% rating as Wellington bus.

Model 2 assesses vehicle age. The constant gives the rating for a brand new train at 84%. The bus constant (BUS) subtracts 9% to a give a rating for a brand new bus of 75%. Thus, like for like, a new train was rated 9% higher than a new bus. Age reduced the train rating by 2% per year so that a 10-year-old train was rated at 67%. For bus, the effect of age was the sum of the AGE and Bus*AGE parameters which implied a reduction of 0.6% per year. Thus after 10 years, a bus was rated at 69% which was slightly above a 10-year-old train.

Table 5.24 Overall vehicle rating models using individual response data

Model	Description	Variable	Linear			Logit		
			Beta	STE	|t|	Beta	STE	|t|
1	City (Base = Christchurch)	Wellington	0.097	0.006	16.2	0.498	0.032	15.6
		Auckland	-0.014	0.007	2.0	-0.065	0.036	1.8
		WTN*Bus	-0.076	0.005	15.2	-0.401	0.026	15.4
		AUC*Bus	0.036	0.006	6.0	0.170	0.029	5.9
		Constant	0.683	0.005	136.6	0.768	0.027	28.4
2	Vehicle age (years)	BUS	-0.091	0.006	16.3	-0.533	0.030	17.8
		AGE	-0.017	0.001	30.4	-0.089	0.003	29.7
		BUS*AGE	0.011	0.001	15.7	0.061	0.004	15.3
		Constant	0.837	0.004	204.1	1.600	0.022	72.7

[33] For the variables (ie excluding the model constant), the average ratio of the logistic parameter over the linear parameter in table 5.24 is 4.9. The average ratio for the constant is 1.5 times larger.

[34] Robust estimation corrects for heteroscedastic errors (non-constant variance that otherwise increases the standard errors relative to the parameter estimate thereby reducing the t value and level of statistical significance). After correction, the t values for the variable parameters were effectively the same as for the linear model. The only difference was the constant where the t values were around half the size of the logistic model because it is compared with 0.5 and not zero. The parameter values themselves are not affected by robust estimation.

Model	Description	Variable	Linear			Logit		
			Beta	STE	|t|	Beta	STE	|t|
3	Vehicle age and seats (number)	BUS	-0.143	0.018	8.1	-0.768	0.091	8.4
		AGE	-0.017	0.001	30.4	-0.089	0.003	29.7
		BUS*AGE	0.011	0.001	15.5	0.061	0.004	15.3
		BUS*SEATS	0.001	0.0004	3.1	0.005	0.0020	2.5
		Constant	0.837	0.004	204.1	1.600	0.022	72.7
4	Euro emissions standard	BUS	-0.105	0.013	8.4	-0.497	0.062	8.0
		EURO1	0.013	0.014	1.0	0.055	0.066	0.8
		EURO2	0.033	0.015	2.2	0.146	0.076	1.9
		EURO3	0.054	0.013	4.2	0.244	0.063	3.9
		EURO4	0.067	0.013	5.2	0.305	0.065	4.7
		EURO5	0.113	0.013	8.7	0.542	0.066	8.2
		Trolley bus	0.090	0.016	5.6	0.422	0.079	5.3
		Constant	0.746	0.003	248.7	1.075	0.015	71.7
5	Air conditioning	BUS	-0.065	0.004	16.3	-0.319	0.021	15.2
		BUS*AC	0.042	0.005	8.4	0.202	0.022	9.2
		Constant	0.746	0.003	248.7	1.075	0.015	71.7
6	Low floor	BUS	-0.095	0.009	10.6	-0.454	0.048	9.5
		BUS*LF	0.054	0.009	6.0	0.246	0.047	5.2
		Constant	0.746	0.003	266.3	1.075	0.015	71.7
7	Wheelchair access	BUS	-0.101	0.008	12.6	-0.480	0.040	12.0
		BUS*WHEELC	0.062	0.008	7.8	0.284	0.039	7.3
		Constant	0.746	0.003	248.7	1.075	0.015	71.7
8	Bus 'premium' route	BUS	-0.052	0.004	13.0	-0.256	0.019	13.5
		BUS * Premium	0.104	0.010	10.9	0.553	0.053	10.4
		Constant	0.746	0.003	248.7	1.075	0.015	71.7
9	Full vehicle model	BUS	-0.171	0.018	9.5	-0.890	0.093	9.6
		AGE	-0.018	0.001	30.0	-0.094	0.003	31.4
		BUS*AGE	0.013	0.001	17.1	0.070	0.004	18.1
		BUS*SEATS	0.001	0.0004	2.6	0.006	0.002	3.0
		BUS * Premium	0.08	0.009	8.9	0.438	0.054	8.1
		Auckland	0.019	0.004	4.8	0.083	0.020	4.2
		Trolley bus	0.023	0.011	2.1	0.107	0.055	2.0
		Constant	0.838	0.004	209.5	1.600	0.022	72.7

Sample size: Models fitted on 11,990 observations

The age and seat capacity model was fitted to the bus and rail observations but with the seat variable applied only to the bus data since the different train types had similar seat capacities. The two age parameters are the same as in model 2. The bus constant becomes more negative reflecting a lower rating for smaller buses. The constant represents a zero seat bus so it is only a 'positioning' parameter. The smallest bus surveyed was just over 20 seats with the BUS*SEATS variable estimating a rating increase of 2%. Thus for a new 20-seater bus, the rating was 72% whereas a new 50-seat bus was rated at 75%.

Model 4 looks at the Euro emissions rating. The constant gives the average rating for the trains over the Auckland and Wellington samples. The BUS coefficient, when added to the constant, gives the rating for a pre Euro-rated bus at 64%. A Euro 1 bus added 1% to the passenger rating of a pre-rated bus, a Euro 2 added 3%, a Euro 3 added 5% and a Euro 4 added 7%. The largest increase was for a Euro 5 bus which added 11%. An electric Wellington trolley bus added slightly less to the rating (9%).

Model 5 looks at air conditioning on buses which added 4% to the average bus rating.

Model 6 looks at low floor buses which added 5%; this was slightly less than wheelchair accessible buses in model 7 which increased the rating by 6%.

Model 8 looks at premium bus routes (Wellington Airport Flyer, Auckland Link and Loop and the Northern Express). These routes added 10% to the standard bus rating raising the overall rating to 80%.

Model 9 presents the 'full' model and contains all the statistically significant variables.[35] Bus and train age and bus seat capacity had similar sized coefficients to model 3. Premium bus increases the bus rating by 8% which was slightly less than in model 8. Auckland buses and trains were predicted to be 2% higher and in Wellington, trolley buses added 2%.

Table 5.25 presents the predicted ratings for bus and train for Wellington/Christchurch and Auckland. Standard, premium (prem) and trolley bus ratings are shown for a 42-seat bus.

Table 5.25 Predicted overall vehicle rating with age and vehicle type

	Christchurch & Wellington				Auckland		
Age	Std Bus	Prem Bus	Trolley Bus	Train	Std Bus	Prem Bus	Train
0	72%	80%	74%	83%	74%	82%	84%
1	72%	80%	74%	82%	74%	81%	83%
2	71%	79%	74%	80%	73%	81%	82%
3	71%	79%	73%	79%	73%	80%	80%
4	70%	79%	73%	77%	72%	80%	79%
5	70%	78%	72%	76%	72%	80%	77%
6	69%	78%	72%	74%	71%	79%	75%
7	69%	77%	71%	72%	71%	79%	74%
8	68%	77%	71%	70%	70%	78%	72%
9	68%	77%	70%	68%	70%	78%	70%
10	67%	76%	70%	66%	69%	78%	68%
11	67%	76%	69%	64%	69%	77%	66%
12	66%	75%	69%	62%	68%	77%	64%
13	66%	75%	68%	59%	68%	76%	61%
14	65%	74%	68%	57%	67%	76%	59%
15	65%	74%	67%	55%	66%	75%	57%
16	64%	73%	66%	*52%*	66%	75%	*54%*
17	64%	73%	66%	*50%*	65%	75%	*52%*
18	63%	72%	65%	*48%*	65%	74%	*50%*
19	62%	72%	65%	*45%*	64%	74%	*47%*
20	62%	72%	64%	*43%*	64%	73%	*45%*

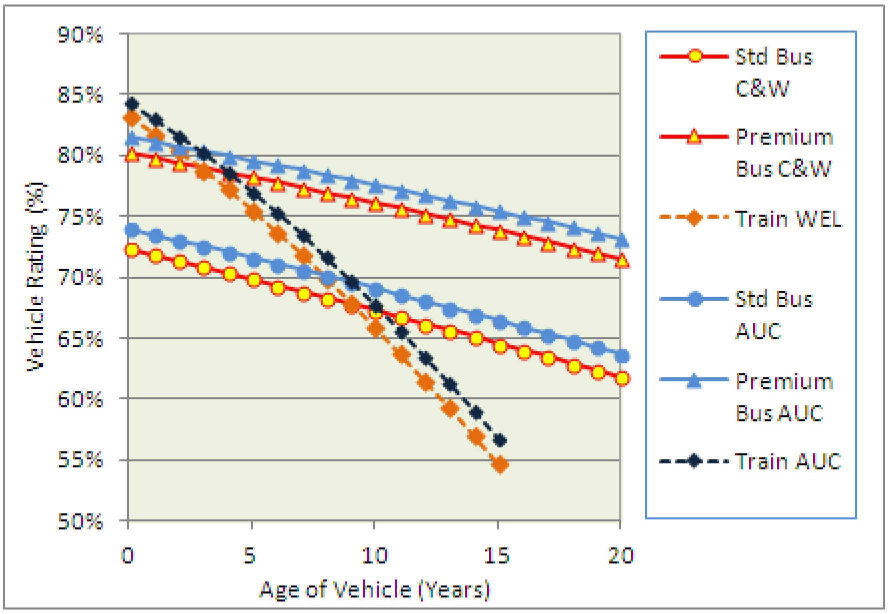
Figures in italics denoted extrapolations of rail data

SP_Qual_Regresults4.xls!BasicQualIVT&StopIAModel

[35] Significant variables were determined by stepwise regression.

Figure 5.23 graphs the relationship (trolley buses were omitted) and shows a much steeper age/rating relationship for trains than buses.

Figure 5.23 Predicted overall vehicle rating with age and vehicle type



5.18 Effect of passenger and trip profile on vehicle ratings

The vehicle ratings were assessed by time of travel, journey purpose, gender, socio-economic status, age group and frequency of use. Tables 5.26 to 5.31 present the ratings for each data classification and figures 5.24 to 5.29 provide histograms of the overall rating.[36]

5.18.1 Time period

In theory, ratings in the off-peak and evening periods should be higher than in the AM and PM peaks since services are operated by newer buses and trains rather than the full fleet.[37]

In fact, the ratings did not reflect this with similar ratings in the AM peak, off-peak and evening period of 72% to 73%. The PM peak was 2% lower at 70% however. Across the attributes, the greatest range in rating was for *information* and *staff*. *Information* rated the highest in the AM peak and lowest in the evening peak. *Wifi* rated lowly across all the periods and only reached 42% in the AM peak.

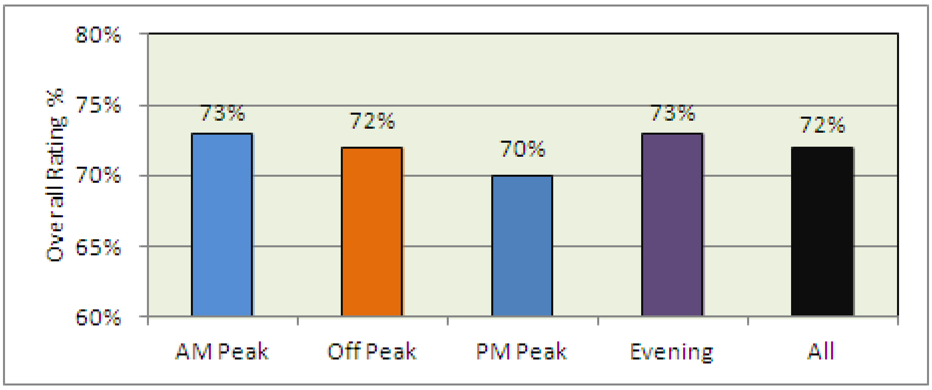
[36] The sample size for the overall rating and the outside vehicle appearance rating is shown as an indicator of the sample sizes for all the individual attribute ratings.

[37] Surveys undertaken during the weekend were classified the same as weekday surveys.

Table 5.26 Vehicle attribute ratings by time period

Time Period	Rating (%)													Sample Size	
	OSApp	OnOff	Seat	Bag	SmQ	AC	Lght	C&G	Info	WIFI	Stff	Env	All	OSApp	All
AM Peak	74%	78%	76%	67%	66%	70%	70%	78%	67%	42%	75%	64%	73%	1,279	2,325
Off Peak	71%	76%	75%	67%	63%	67%	67%	74%	63%	41%	73%	61%	72%	3,580	6,207
PM Peak	73%	78%	73%	65%	63%	67%	67%	77%	63%	38%	71%	60%	70%	1,607	2,640
Evening	73%	79%	77%	68%	65%	69%	69%	78%	62%	41%	76%	62%	73%	417	818
All	72%	77%	75%	66%	64%	68%	68%	75%	64%	41%	73%	62%	72%	6,883	11,990
High	AM	EV	EV	EV	AM	AM	AM	AM	AM	AM	EV	AM	AM	na	na
Low	OP	OP	PM	PM	OP	OP	OP	OP	EV	PM	PM	PM	PM	na	na
Range	3%	3%	4%	3%	3%	3%	3%	4%	5%	4%	5%	4%	3%	na	na

Figure 5.24 Overall vehicle rating by time period



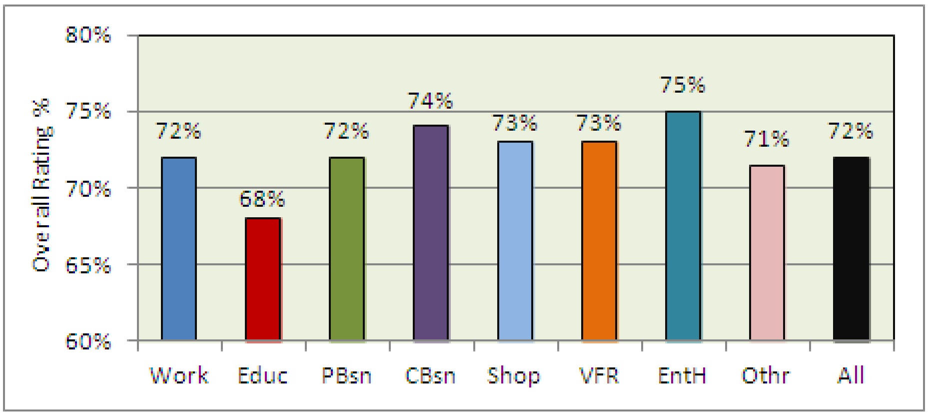
5.18.2 Journey purpose

Respondents travelling to/from education tended to rate the lowest and passengers travelling on company business the highest. The range was greatest for the *environmental* rating with education trips rating at 57% compared with company business trips at 69%.

Table 5.27 Vehicle attribute ratings by journey purpose

Trip Purpose	Rating (%)												Sample Size		
	OSApp	OnOff	Seat	Bag	SmQ	AC	Lght	C&G	Info	WIFI	Stff	Env	All	OSApp	All
Work	74%	79%	75%	67%	65%	69%	69%	78%	65%	41%	73%	63%	72%	3,119	5,375
Educ	69%	75%	73%	63%	57%	64%	64%	71%	59%	34%	71%	57%	68%	1,037	1,965
P.Busn	71%	76%	76%	67%	65%	67%	67%	73%	62%	42%	75%	61%	72%	646	1,152
C.Busn	75%	75%	78%	71%	68%	70%	70%	81%	70%	43%	76%	69%	74%	63	136
Shop	71%	76%	77%	68%	63%	67%	67%	74%	66%	45%	74%	62%	73%	684	1,081
VFR	74%	77%	78%	69%	66%	69%	69%	76%	65%	41%	75%	63%	73%	545	996
Ent/Hol	73%	75%	76%	69%	64%	69%	69%	76%	67%	45%	74%	64%	75%	560	906
Other	72%	77%	76%	69%	62%	69%	69%	74%	66%	45%	73%	61%	71%	130	207
All	73%	77%	75%	67%	64%	68%	68%	76%	64%	41%	73%	62%	72%	6,792	11,837
High	CBsn	Work	CBsn	CBsn	CBsn	CBsn	CBsn	CBsn	CBsn	Shop	CBsn	CBsn	EntH	na	na
Low	Educ	Educ	Educ	Educ	Educ	Educ	Educ	Educ	Educ	Educ	Educ	Educ	Educ	na	na
Range	6%	4%	5%	8%	11%	6%	6%	10%	11%	11%	5%	12%	7%	na	na

Figure 5.25 Overall vehicle rating by journey purpose



Note: VFR = visit friends/relatives

5.18.3 Gender

Females tended to give slightly higher ratings than males. For the *overall* rating, the difference was 2% with females giving a rating of 73% and males 71%.[38]

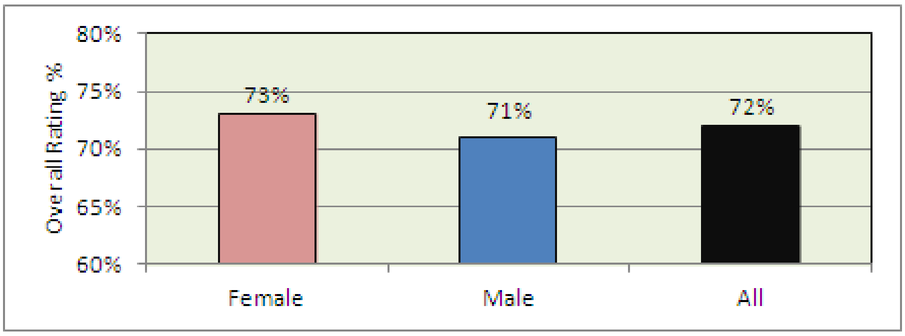
The difference was greatest at 4% for *wifi* with a 3% difference for *smoothness and quietness*.

The only exception was *ease of on/off* with males rating 1% higher.

Table 5.28 Vehicle attribute ratings by gender

	Rating (%)														
Gender	OSApp	OnOff	Seat	Bag	SmQ	AC	Lght	C&G	Info	WIFI	Stff	Env	All	OSApp	All
Female	73%	77%	76%	67%	65%	68%	68%	76%	64%	42%	74%	62%	73%	3,771	6,658
Male	72%	78%	75%	66%	62%	67%	67%	75%	63%	38%	73%	61%	71%	2,932	5,120
All	73%	77%	73%	67%	64%	68%	68%	76%	64%	40%	73%	62%	72%	6,703	11,778
Max	Fem	Male	Fem	Fem	Fem	Fem	Fem	Fem	Fem	Fem	Fem	Fem	Fem	na	na
Range	1%	1%	1%	1%	3%	1%	1%	1%	1%	4%	1%	1%	2%	na	na

Figure 5.26 Vehicle attribute ratings by gender



[38] The large sample sizes make the 2% point difference statistically significant at the 95% level.

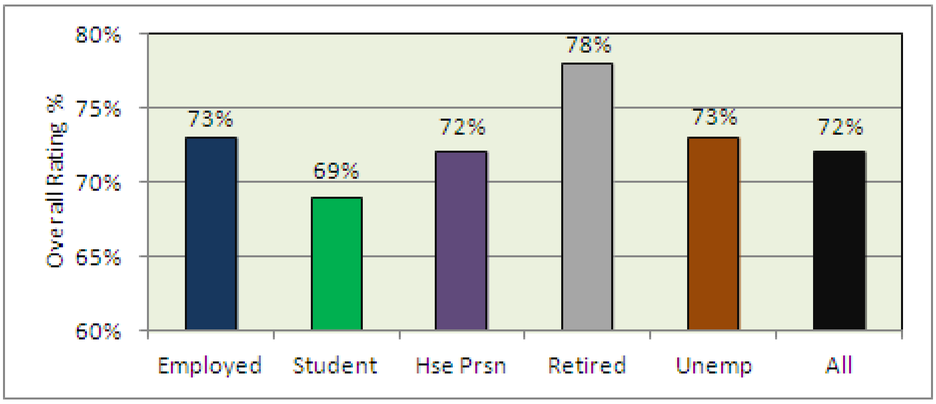
5.18.4 Socio-economic status

Retired passengers tended to rated highest and students the lowest. For the *overall* rating, the difference was 9% with retired passengers scoring vehicle attributes at 78% compared with students at 69%.

Table 5.29 Vehicle attribute ratings by socio-economic status

Socio-Econ	Rating (%)													Sample Size	
Status	OSAp	OnOff	Seat	Bag	SmQ	AC	Lght	C&G	Info	WIFI	Stff	Env	All	OSAp	All
Employed	74%	79%	76%	67%	65%	69%	69%	77%	65%	38%	74%	63%	73%	3,837	6,772
Student	69%	75%	73%	63%	59%	65%	65%	71%	60%	41%	70%	58%	69%	2,080	3,681
Hse Prsn	69%	71%	74%	68%	66%	69%	69%	74%	65%	43%	74%	63%	72%	164	324
Retired	75%	76%	80%	72%	69%	71%	71%	79%	71%	51%	80%	69%	78%	520	735
Unemp	72%	77%	76%	67%	63%	67%	67%	72%	64%	56%	74%	63%	73%	176	357
All	72%	77%	75%	66%	64%	68%	68%	75%	64%	48%	73%	62%	72%	6,777	11,869
High	Ret	Emp	Ret	Ret	Ret	Ret	Ret	Ret	Ret	UnE	Ret	Ret	Ret	na	na
Low	Std	HPr	Std	Std	Std	Std	Std	Std	Std	Emp	Std	Std	Std	na	na
Range	6%	8%	7%	9%	10%	6%	6%	8%	11%	18%	10%	11%	9%	na	na

Figure 5.27 Overall vehicle rating by socio-economic status



5.18.5 Personal income

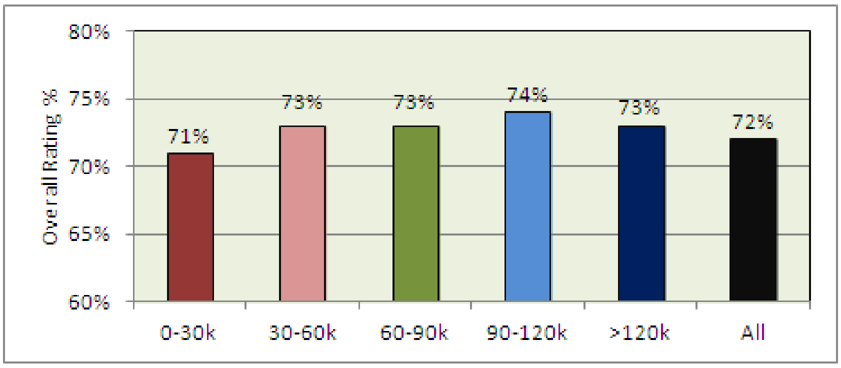
Personal income was included in the SP questionnaire but not in the rating questionnaire. A synthetic estimate was generated for each rating response using a probabilistic method that utilised the relationship between income and socio-economic status/occupation as estimated by the SP survey. The method is described in more detail in section 7.18.

The attribute ratings are cross tabulated against income in table 5.30 which shows a weak positive correlation. For all the attributes except *seat availability/comfort*, the rating was lowest for passengers in the lowest income category ($0–30,000). The highest ratings were in the $60,000 to $90,000 or $90,000 to $120,000 categories. The income relationship was not strong, however, with only a 3% range in the *overall* rating (71% to 74%).

Table 5.30 Vehicle attribute ratings by personal income

Annual Income $k	Rating (%)													Sample Size	
	OSApp	OnOff	Seat	Bag	SmQ	AC	Lght	C&G	Info	WIFI	Stff	Env	All	OSApp	All
0-30	71%	76%	74%	65%	62%	66%	66%	74%	62%	39%	73%	60%	71%	3,452	6,076
30-60	73%	78%	75%	67%	65%	69%	69%	77%	65%	42%	74%	63%	73%	1,702	3,006
60-90	74%	78%	76%	68%	67%	69%	69%	78%	66%	42%	73%	62%	73%	977	1,622
90-120	75%	79%	76%	68%	66%	71%	71%	79%	66%	46%	75%	64%	74%	439	762
>120	73%	78%	73%	66%	65%	68%	68%	76%	64%	39%	74%	62%	73%	313	524
All	72%	77%	74%	66%	64%	68%	68%	75%	64%	41%	73%	62%	72%	6,883	11,990
High	90-120	90-120	60-90	60-90	60-90	90-120	90-120	90-120	60-90	90-120	90-120	90-120	90-120	na	na
Low	0-30	0-30	>120	0-30	0-30	0-30	0-30	0-30	0-30	0-30	0-30	0-30	0-30	na	na
Range	4%	3%	3%	3%	5%	5%	5%	5%	4%	7%	2%	4%	3%	na	na

Figure 5.28 Overall vehicle rating with personal income



5.18.6 Age of respondent

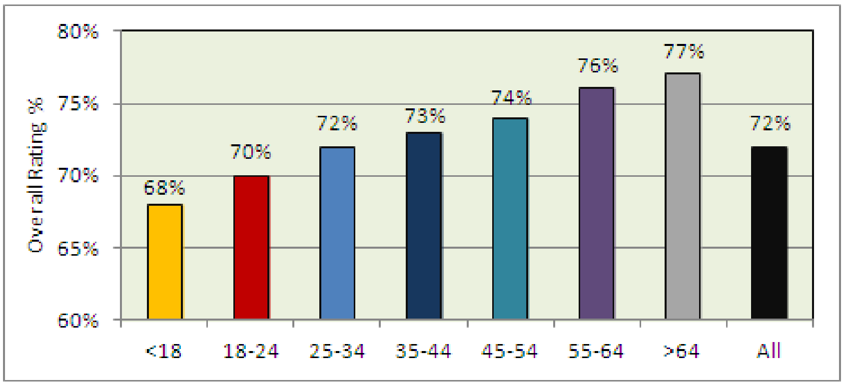
The *overall* rating increased gradually with the age of the respondent, rising from 68% for respondents aged under 18 to 77% for respondents aged over 64.

The positive age – rating relationship was present for all the attribute ratings and was most marked for *ability to use your computer and connect to the internet*, with respondents over 64 rating at 77% compared with 35% for under 18 year olds.

Table 5.31 Vehicle attribute ratings by age group

Age Group	Rating (%)													Sample Size	
	OSApp	OnOff	Seat	Bag	SmQ	AC	Lght	C&G	Info	WIFI	Stff	Env	All	OSApp	All
<18	68%	73%	72%	63%	56%	62%	62%	68%	59%	35%	68%	58%	68%	851	1,447
18-24	70%	76%	74%	64%	61%	66%	66%	73%	61%	37%	72%	59%	70%	1,854	3,402
25-34	74%	78%	76%	67%	64%	69%	69%	77%	64%	40%	73%	61%	72%	1,254	2,243
35-44	74%	78%	74%	67%	66%	69%	69%	77%	65%	43%	73%	62%	73%	955	1,646
45-54	75%	79%	76%	68%	68%	70%	70%	80%	67%	48%	75%	65%	74%	752	1,403
55-64	75%	78%	77%	70%	69%	72%	72%	79%	68%	52%	76%	67%	76%	560	904
>64	76%	77%	80%	71%	69%	71%	71%	79%	71%	60%	80%	69%	77%	595	858
All	73%	77%	75%	66%	64%	68%	68%	75%	64%	41%	73%	62%	72%	6,821	11,903
High	>64	45-54	>64	>64	55-64	55-64	55-64	45-54	>64	>64	>64	>64	>64	na	na
Low	<18	<18	<18	<18	<18	<18	<18	<18	<18	<18	<18	<18	<18	na	na
Range	8%	6%	8%	8%	13%	10%	10%	12%	12%	25%	12%	11%	9%	na	na

Figure 5.29 Overall vehicle attribute ratings by age group



5.18.7 Frequency of use

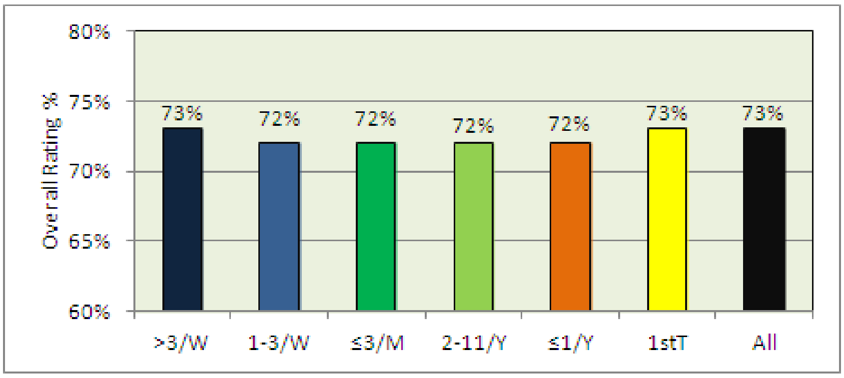
There was little difference in rating according to the frequency of use of bus and rail with the *overall* rating varying by only 1%.

There was a greater range for *wifi* and *information*. Infrequent users tended to give higher ratings than frequent users which probably reflected a better provision of information on services like the Airport Flyer, Link and Loop services in Auckland and the Wairarapa rail line where a greater proportion of passengers were infrequent users.

Table 5.32 Vehicle attribute ratings by frequency of use

Frequency	Rating (%)													Sample Size	
of Use	OSApp	OnOff	Seat	Bag	SmQ	AC	Lght	C&G	Info	WIFI	Stff	Env	All	OSApp	All
>3/Wk	72%	78%	74%	66%	63%	67%	67%	75%	63%	38%	73%	61%	73%	4,011	3,991
1-3/W	71%	77%	77%	67%	63%	68%	68%	75%	63%	41%	74%	62%	72%	1,297	1,302
≤3/M	71%	75%	77%	68%	66%	70%	70%	77%	68%	43%	74%	63%	72%	600	602
2-11/Y	72%	76%	76%	69%	65%	70%	70%	77%	70%	51%	75%	64%	72%	434	438
≤1/Y	69%	74%	77%	70%	67%	70%	70%	77%	70%	56%	74%	67%	72%	151	146
1stTime	73%	75%	76%	65%	63%	71%	71%	77%	66%	48%	74%	66%	73%	164	165
All	72%	77%	75%	67%	64%	68%	68%	76%	64%	40%	73%	62%	73%	6,657	6,644
High	1stT	>3/W	-	≤1/Y	≤1/Y	1stT	1stT	≤3/M	2-11/Y	≤1/Y	2-11/Y	≤1/Y	>3/W	na	na
Low	≤1/Y	≤1/Y	>3/W	1stT	>3/W	>3/W	>3/W	>3/W	>3/W	>3/W	>3/W	>3/W	-	na	na
Range	4%	4%	3%	5%	4%	4%	4%	2%	7%	18%	2%	6%	1%	na	na

Figure 5.30 Overall vehicle rating by frequency of use



5.18.8 Individual response model

Profile models were fitted (see section 5.17) to the individual response data (11,990 observations). Five models were fitted (with the numbering system continuing on from table 5.24) and then a 'full model' (#17) that input only the significant variables. Table 5.33 presents the models fitted.

Table 5.33 Overall vehicle rating models using individual response profile data

Model	Desc	Variable	Linear Beta	Linear STE	Linear |t|	Logit Beta	Logit STE	Logit |t|
10	Time Period	Off Pk	-0.018	0.005	3.5	-0.091	0.024	3.8
		PM Pk	-0.030	0.006	5.0	-0.150	0.028	5.4
		Evening	-0.007	0.008	0.9	-0.037	0.041	0.9
		Weekend	0.015	0.005	3.0	0.073	0.028	2.6
		Constant	0.733	0.004	174.5	1.012	0.020	50.6
11	Trip Purpose	Educ	-0.039	0.005	7.8	-0.186	0.025	7.4
		Pers Busn	0.000	0.006	0.0	0.000	0.033	0.0
		Comp Busn	0.021	0.017	1.2	0.107	0.087	1.2
		Shop	0.006	0.007	0.8	0.028	0.034	0.8
		VFR	0.009	0.007	1.3	0.044	0.034	1.3
		Ent/Hol	0.027	0.007	3.8	0.140	0.037	3.8
		Constant	0.722	0.003	277.7	0.953	0.013	73.3
12	Gender	Female	0.016	0.004	4.2	0.077	0.018	4.3
		Constant	0.710	0.003	259.1	0.896	0.014	64.0
13	Respondent Age	Under 18	-0.047	0.006	8.1	-0.229	0.028	8.1
		Age 18-24	-0.035	0.004	8.3	-0.171	0.021	8.1
		Over 64	0.039	0.007	5.4	0.211	0.039	5.4
		Constant	0.732	0.003	292.8	1.003	0.013	79.6
14	Socio-Economic Status	Student	-0.034	0.004	8.6	-0.167	0.020	8.4
		HsePers	-0.002	0.011	0.2	-0.009	0.062	0.1
		Retired	0.050	0.008	6.5	0.267	0.042	6.4
		Unemployed	0.002	0.011	0.2	0.010	0.057	0.2
		Constant	0.726	0.002	302.6	0.977	0.012	81.4
15	Frequency of Use	Occasional	0.020	0.010	2.0	0.010	0.050	0.2
		Rare	0.030	0.012	2.6	0.152	0.063	2.4
		Constant	0.717	0.002	377.4	0.931	0.009	103.4
16	Personal Income $k	PY	0.00031	0.00005	5.8	0.0016	0.000	5.9
		Constant	0.706	0.00289	243.9	0.874	0.014	60.7
17	Full Profile Model	PM Peak	-0.030	0.005	5.7	-0.148	0.026	5.8
		Off Peak	-0.014	0.004	3.1	-0.070	0.022	3.2
		Education	-0.017	0.006	3.0	-0.076	0.027	2.8
		Ent/Hol	0.032	0.007	4.5	0.164	0.036	4.5
		VFR	0.017	0.007	2.5	0.086	0.034	2.5
		Female	0.017	0.004	4.6	0.084	0.018	4.6
		Retired	0.041	0.008	5.2	0.225	0.043	5.2
		Under 18	-0.041	0.006	6.4	-0.201	0.032	6.3
		Age18-24	-0.029	0.005	6.1	-0.142	0.024	6.0
		Income $k	0.00013	0.0001	2.1	0.0007	0.000	2.2
		Constant	0.727	0.006	127.2	0.982	0.029	34.2

In models 1–15, the constant represents the 'omitted group'. Thus in the time period model, the constant represents the AM peak and in the gender model, the constant represents males. Given that all the variables (except income) are categorical, the individual observation models accord closely to the result of the aggregated analysis but with measures of statistical confidence added.

The time period model (model 10) shows ratings in the off-peak (-1.8%) and PM peak (-3%) to be significantly lower than in the AM peak with weekend ratings significantly higher (1.5%).

The trip purpose model (11) shows respondents making education trips to/from school, college or university to give an overall rating 3.9% lower than respondents commuting to/from work (the constant). Respondents making an entertainment/holiday trip rated their vehicle significantly higher (2.7%). Other trip purposes such as personal business and company business trips were similar to work commuting trips.

Females (model 12) rated 1.6% higher than males (with the difference statistically significant).

In the age model (13) respondents under 24 rated 4.7% lower than respondents aged 25 to 64, whereas respondents aged over 64 rated 3.9% higher.

Reflecting the age group findings, the occupation model (14) found students to rate 3.4% lower than employed respondents and retired passengers to rate 5% higher. There were no other significant differences.

In terms of frequency of use (15), occasional users (defined as using the bus or train service less than three times a month but more than once a year) rated 2% higher than frequent users (more than three times a month) with rare users (once a year or first-time users) rating 3% higher.

Ratings increased with personal income (16) but the effect was weak. Increasing income from zero to $100,000 increased the rating by 3.1%.

The full model (17) contains the profile variables that were statistically significant at the 95% confidence level.[39] The significant variables were off-peak and the PM peak; education, entertainment/holiday and visiting friends and relatives; female; retired; respondents aged under 18 and respondents aged 18 to 24; and personal income.

5.19 Vehicle and respondent profile model

The significant explanatory variables in the full vehicle model (model 9 in table 5.24) and the full respondent profile model (model 17 in table 5.33) were included in a grand final model (model 18) which is shown in table 5.34.

The grand final model included 14 variables.

Two vehicle age variables were included that distinguished buses from trains. The vehicle type variables included in model 9 were included with parameter size changing only slightly. There was a small increase in the Auckland coefficient (from 1.9% to 2.4%) and also in the trolley bus coefficient (from 1.9% to 2.7%). The other vehicle type parameters were largely unaffected.

Four respondent and trip profile variables were omitted from the grand final model (off-peak, education trips and personal income). The coefficients for the retained variables were similar to model 17 but there were some changes with the coefficient for retired passengers increasing (3.9% to 5.5%) and that for younger respondents decreasing (4.5% to 3.5% for under 18s and 3.2% to 1.9% for 18–24 year olds) which probably reflected a greater likelihood of younger people travelling on older buses and trains.

[39] Significant variables were determined by stepwise regression.

Table 5.34 Grand final model of overall vehicle rating using individual response data

Model	Desc	Variable	Linear			Logit		
			Beta	STE	|t|	Beta	STE	|t|
18	Grand Final Model	Bus	-0.169	0.018	9.4	-0.881	0.093	9.5
		Vehicle Age	-0.0188	0.0006	30.8	-0.097	0.003	32.3
		Bus*Age	0.014	0.001	18.7	0.073	0.004	18.3
		Bus * Seats	0.0012	0.000	3.1	0.005	0.002	2.5
		Bus * Premium	0.067	0.009	7.4	0.375	0.054	6.9
		Auckland	0.024	0.004	6.0	0.107	0.020	5.4
		Trolley Bus	0.027	0.011	2.5	0.129	0.054	2.4
		PM Peak	-0.024	0.004	6.0	-0.116	0.021	5.5
		Ent/Hol	0.038	0.007	5.8	0.195	0.035	5.6
		VFR	0.018	0.006	2.9	0.089	0.032	2.8
		Female	0.016	0.003	5.3	0.079	0.018	4.4
		Retired	0.055	0.007	7.4	0.298	0.041	7.3
		Under 18	-0.035	0.006	6.3	-0.168	0.028	6.0
		Aged 18 - 24	-0.019	0.004	4.8	-0.093	0.021	4.4
		Constant	0.837	0.068	12.3	1.596	0.025	63.8

5.20 Relative importance of vehicle attributes

The relative importance of attributes such as *staff* and *cleanliness and graffiti* was assessed by their rating's ability to explain the *overall* vehicle rating. So analysed, changes in the quality of individual atttibutes could be assessed and ultimately valued. Thus for instance, the impact of cleaner buses could be assessed through knowledge of the initial cleanliness rating, the initial overall vehicle rating and the predicted cleanliness rating after improvement.

The sample size on which the models were estimated reduced to 6,800 observations since only the rating survey provided attribute ratings. A noteworthy aspect was the treatment of respondents who did not rate an individual attribute but instead left it blank. Unlike the preceding analysis, these responses were included but treated as a zero rating. Implicitly therefore, anyone not rating an attribute was treated as considering the attribute as unimportant (as per the questionnaire instructions).[40]

Linear and logistic models (to constrain the proportional rating to the 0-1 interval) were fitted to the data as shown by equation 5.6.[41]

$$\Pr R_{ALL} = \alpha + \sum \beta_X \Pr R_X \qquad \text{(Equation 5.6)}$$

$$\Pr R_{ALL} = \frac{\exp(\alpha + \sum \beta_X \Pr R_X)}{1 + \exp\{\alpha + \sum \beta_X \Pr R_X\}} \;..$$

Where:

R_{ALL} = overall rating on 0-1 scale

R_X = rating of attribute X on 0-1 scale

α, β = estimated parameters.

[40] For completeness, the rating for toilet availability and cleanliness was included even though it was only included in the Wairarapa line questionnaire.

[41] A 'probit' model was also fitted. The probit has longer 'tails' than the logit. When fitted, there was little difference in the parameter estimates and since the probit is computationally more difficult to use, the logit model was preferred.

Table 5.35 presents the parameter estimates, the average rating, the percentage of respondents giving a rating and the adjusted rating (with non ratings treated as a zero rating). As can be seen, only 2% provided a rating for *toilet availability and cleanliness*, as this attribute was only included in the Wairarapa questionnaire. The other attribute where response was noticeably lower was *computer and internet* where 71% provided a rating which reduced the average rating from 41% to 29%.

Table 5.35 Vehicle rating explanatory model using individual attribute ratings

Variable	Rate %	Rating given %	Adjusted rate %	Linear			Logit		
				β	STE	|t|	β	STE	|t|
Outside appearance	72%	99%	72%	0.122	0.009	13.6	0.64	0.066	9.7
Ease of on and off	77%	99%	76%	0.066	0.009	7.3	0.346	0.065	5.3
Seat availability and comfort	74%	99%	74%	0.116	0.009	12.9	0.57	0.065	8.8
Space for bags	66%	98%	65%	0.027	0.008	3.4	0.195	0.052	3.8
Smoothness and quietness	64%	99%	63%	0.125	0.008	15.6	0.669	0.056	11.9
Heating and air conditioning	69%	98%	66%	0.065	0.009	7.6	0.334	0.057	5.9
Lighting	75%	97%	73%	0.023	0.009	2.6	0.114	0.057	2.0
Inside cleanliness and graffiti	75%	98%	74%	0.086	0.008	10.8	0.381	0.055	6.9
Toilet avail. and cleanliness	76%	2%	1%	0.022	0.015	1.5	0.105	0.071	1.5
Info and announcements	64%	95%	61%	0.049	0.006	8.3	0.302	0.038	7.9
Computer and internet (wifi)	41%	71%	29%	0.004	0.005	0.9	0.051	0.032	1.6
Driver/staff	73%	98%	72%	0.126	0.007	18.0	0.664	0.050	13.3
Environmental impact	62%	92%	56%	0.074	0.006	12.3	0.465	0.042	11.1
Constant (α)[a]	72%	100%	72%	0.117	0.006	19.5	-2.133	0.053	40.2

[(a)] Overall ratings tabulated

Models fitted on 6,800 observations

All the parameters except *toilet availability and cleanliness* and *computer and internet* were significant (95% confidence level). The most significant variable was *driver/staff* which had a t value of 18 in the linear model (13.3 in the logit model).

The relative importance of the attributes is most easily assessed by inspection of the linear model since the coefficients sum to one (subject to rounding). The largest coefficients and hence most important attributes were *driver/staff* (which accounted for 12.6% of the variation in the overall rating), *smoothness and quietness* (12.5%), *outside appearance* (12.2%) and *seat availability* (11.6%).[42]

The second tier attributes were *ease of on/off* (6.6%), *heating and air conditioning* (6.5%), *inside cleanliness and graffiti (*8.6%), *information and announcements* (4.9%) and *environmental impact* (7.4%).

The attributes of low importance were *space for bags* (2.7%), *lighting* (2.3%), *toilet availability and cleanliness* (2.2%), *computer and internet* (0.4%).

The constant was estimated at 11.7%.[43]

[42] Explanatory power is measured with the constant excluded.

[43] There was an argument for omitting the constant from the model since if all the attributes were rated ‘very poor’ (0%), the overall rating should also be expected to be rated as ’very poor’.

As stated previously, the advantage of the logit model is that the predicted ratings are constrained to lie within the range 0% and 100%. The 'S' shape also means that improvements have their greatest effect on mid-range ratings, whereas at low or high ratings the impact is weaker.[44]

Respecifying the logit model 'incrementally' as shown in equation 5.7 offers the additional advantage of requiring only information on the attribute(s) subject to change:

$$R_{ALL}^{new} = \frac{R_{ALL}\left[\exp\left\{\sum \beta \Delta Xi\right\}\right]}{R_{ALL}\left[\exp \sum \beta \Delta Xi\right] + \left[1 - R_{ALL}\right]} \quad \text{(Equation 5.7)}$$

$$= \frac{0.67 \exp\left\{0.64 x (0.72 - 0.62\right\}}{0.67 \exp\left\{0.64 x (0.72 - 0.62\right\} + (1 - 0.67)} = 0.72$$

As an example, a proposal to refurbish the exterior of Auckland trains needs to be evaluated. Figures are taken from table 5.4 (Auckland rail) and give a base *overall* train rating of 67% and a base *outside appearance* rating of 62%. Refurbishment is expected to increase the *outside appearance* rating by 10 percentage points to 77%. Using equation 5.7, the new *overall* train rating would be predicted to increase to 72% after plugging in the importance parameter estimate of 0.64 from table 5.35.

5.21 Vehicle attribute importance and comparison with Gravitas Auckland survey

A similar model was estimated on the Gravitas survey data (section 2.4). Table 5.36 compares the models in terms of the implied importance of individual vehicle attributes (with importance measured by the relative size of the attribute parameter estimate).

Linear and logit models were fitted but as can be seen, there was little difference between them.

Direct comparison with the Gravitas model is hampered by differences in the attribute list and differences in attribute descriptions. That said, the Gravitas survey gave a greater importance to *ease of boarding/alighting* (listed as two different attributes and summed) and *cleanliness and graffiti* (listed separately).

[44] Within the range 0.2 to 0.8, the logit curve is almost a straight line. Only outside this range does the curve bend noticeably.

Table 5.36 Relative importance of individual vehicle attributes in explaining overall vehicle rating

	Pricing Strategies		Gravitas (Auckland)	
	Linear	Logit	Bus	Rail
Outside Appearance^	13%	13%	-	6%
Ease of On & Off+	7%	7%	22%	21%
Seat Availability & Comfort	13%	12%	12%	15%
Space for Bags	3%	4%	-	-
Smoothness & Quietness	14%	14%	-	-
Heating & Air Conditioning	7%	7%	17%	17%
Lighting	3%	2%	-	-
Inside Cleanliness & Graffiti	10%	8%	18%	18%
Toilet Availability & Cleanliness	2%	2%	-	-
Information & Announcements	5%	6%	-	5%
Computer & Internet (WIFI)	0.4%	1.1%	-	-
Driver/Staff	14%	14%	-	-
Environmental Impact	8%	10%	18%	-
Graffiti	na	na	13%	18%
All	100%	100%	100%	100%

^ described as cleanliness of the outside of the train on the Gravitas q'aire
+ listed on the Gravitas q'aire separately once as boarding and once as alighting

5.22 Allowing for variations in attribute importance by market segment

The model was extended to allow for differences in attribute importance by market segment. To do this, a set of 'dummy' variables was introduced as equation 5.8 shows for the linear model.

$$\Pr R_{ALL} = \alpha + \sum_{x} \beta_x \Pr R_x + \sum_{x} \sum_{m} \beta_{xm} M_x \Pr R_x \qquad \text{(Equation 5.8)}$$

Given that the base attribute was retained, one of the market segment profile classes needed to be omitted. Thus for gender only an interaction term for females was introduced (males being the base group) .

In total, 21 characteristics were assessed which when multiplied by the 13 rating attributes produced 273 variables on top of the 13 base variables. This was too large to assess in one pass so the market segment variables were assessed sequentially. Ten market segment models were fitted first with significant variables (at the 95% confidence level) included in a grand final model. The significant variables for the 10 market segment models are summarised in table 5.37.

The first model distinguished bus from rail respondents but found no significant differences.

The second model looked at trip length. Response was categorised into short (<20 minutes onboard time) and long (over 40 minutes) trips. Short-distance trips attached relatively less weight to the *environment* rating (shown as a blue shaded box with a minus sign) and a greater weight to *space for belongings* which is shown as a red shaded box with a plus sign. Respondents making long trips attached greater importance to *toilet availability/cleanliness* and *lighting* but less importance to *onboard staff*. Here, the greater toilet weighting was expected since the attribute was only included on the longer distance Wairarapa questionnaire.

Non-peak respondents (model 3) attached more importance to *toilets* and *heating/air conditioning*.

There was no difference according to whether the survey was undertaken during daylight or night time (model 4).

In terms of city (model 5), Christchurch respondents attached less weight to *lighting* and more to *staff* whereas Wellington respondents attached more importance to *smoothness/quietness* and less to *staff* and the *environment*.

Relatively few journey purpose effects (model 6) were significant. There were no differences between respondents travelling to/from education and commuters travelling to/from work or respondents making company business trips. However, respondents making personal business trips were more sensitive to *outside appearance* and less sensitive to *heating/air conditioning*. Shopping trips were more sensitive to *staff* and less to the *environment*. Respondents visiting friend/relatives were more sensitive to *seating* and less to the *environment*. Respondents making entertainment or holiday trips attached more importance to the *environment*.

Table 5.37 Variation in attribute importance by market segment

		Attribute Importance												
Category	Group	OSAP	OnOff	Seat	Bags	SmQ	HtAC	Lght	C&G	Toilet	Info	WIFI	Staff	Env
1. Mode	Bus													
2. Length	Short < 20 mins				+									-
	Long > 40 mins							+		+			-	
3. Period	Non Peak						+			+				
4. Light	Dark													
5. City	Christchurch							-					+	
	Wellington					+							-	-
6. Journey Purpose	Education													
	Personal Busn	+					-							
	Company Busn													
	Shopping												+	-
	VFR			+										-
	Ent/Hol													+
7. Gender	Female								+					-
8. Socio-Econ Status	Student													
	Hse Person				-							-		+
	Retired			+				+						-
	Unemployed						-			-				
9. Income	PY$k								+					-
10. Age Group	<18			-					+					
	18-25	-												
	>64									-				-

Females attached more weight to *cleanliness/graffiti* but less to the *environment* when compared with males (model 7).

In terms of socio-economic status (model 8) there were no differences between students and employed passengers but there were eight significant effects between other employment groups: housepersons attached less importance to the *space for personal belongings* and *wifi* and more importance to the *environment*. Retired passengers attached more importance to *seating* and to *lighting* but less to the *environment*. Unemployed passengers attached less importance to *heating/air conditioning* and *toilet availability/cleanliness*.

Passengers with higher incomes attached more importance to the *cleanliness/graffiti* of the vehicle but less to the *environment* rating of the vehicle (model 9).

Five age effects were significant (model 10). Young respondents (aged under 18) attached more importance to *cleanliness/graffiti* and less to *seating.* Passengers aged 18–25 attached less importance to the *outside appearance* of the vehicle. Passengers aged over 64 attached less importance to *toilet availability/cleanliness* and to the *environment* rating.

5.23 Development of a grand final model of attribute importance

The significant variables from the 10 market segment models (table 5.37) were tested in a 'grand final model' which is presented in table 5.38. Ten market segment effects remained statistically significant.

Table 5.38 Vehicle rating explanatory grand final model

Variable	Linear			Logit		
	β	STE	|t|	β	STE	|t|
Outside appearance (OSAPP)	0.120	0.009	13.3	0.640	0.065	9.8
Ease of on and off (ONOFF)	0.075	0.009	8.3	0.408	0.064	6.4
Seat availability and comfort (SEAT)	0.102	0.009	11.3	0.491	0.064	7.7
Space for bags (BAGS)	0.024	0.008	3.0	0.178	0.051	3.5
Smoothness and quietness (SMQU)	0.119	0.008	14.9	0.633	0.055	11.5
Heating and air conditioning (HEAT)	0.062	0.008	7.8	0.324	0.055	5.9
Lighting (LIGHT)	0.029	0.009	3.4	0.153	0.056	2.7
Inside cleanliness and graffiti (CG)	0.065	0.009	7.2	0.269	0.059	4.6
Toilet availability and cleanliness (TOILET)	-	-	-	-	-	-
Information and announcements (INFO)	0.052	0.006	8.7	0.325	0.037	8.8
Computer and internet (WIFI)	0.008	0.005	1.7	0.078	0.032	2.4
Driver/staff (STAFF)	0.123	0.007	18.0	0.647	0.049	13.2
Environmental impact (ENV)	0.106	0.009	12.2	0.614	0.056	11.0
Trip>40mins[a] TOILET	0.013	0.004	3.3	0.066	0.022	3.0
Female[a] ENV	-0.031	0.01	3.1	-0.149	0.069	2.2
Female[a] CG	0.039	0.008	4.6	0.216	0.054	4.0
Retired[a] SEAT	0.090	0.014	6.4	0.495	0.123	4.0
Retired[a] ENV	-0.072	0.017	4.2	-0.258	0.152	1.7
Aged 18–25[a] OSAPP	-0.023	0.005	4.6	-0.151	0.028	5.4
Aged <18[a] SEAT	-0.021	0.005	4.2	-0.151	0.035	4.3
Entertainment/holiday[a] ENV	0.018	0.008	2.3	0.132	0.053	2.5
Visit friends/rels[a] SEAT	0.052	0.014	3.7	0.271	0.104	2.6
Visit friends/rels[a] ENV	-0.054	0.019	2.8	-0.272	0.141	1.9
Constant (α)[a]	0.119	0.004	29.8	-2.132	0.053	40.2

[a] Overall ratings tabulated

Estimated on 6,800 observations

Outside appearance, seat availability/comfort, smoothness/quietness and *staff* were the most important attributes with each attribute explaining just over 10% of the *overall* rating.

The *environmental* rating was the most variable across the market segments with its importance increasing for the 'base group' (males, non-retired passengers who were not visiting friends/relatives) and being especially important for passengers travelling on holiday or making entertainment trips.

Seating was the next most variable with three significant effects: retired passengers and passengers visiting friends/relatives attached more importance to seating with young passengers (<18) attaching less importance.

Females attached more importance to *cleanliness and graffiti* and less to the *environmental* rating compared with males.

Passengers aged 18 to 25 attached less importance to the *outside appearance* of the vehicle.

Passengers making trips longer than 40 minutes attached more importance to *toilet availability/cleanliness*.

In terms of socio-economic status, there was no difference between students and employed passengers. House persons attached a greater weight to the *environment* and less weight to *wifi* and *space for bags*. Retired passengers attached greater weight to the *seat availability and comfort* and to *lighting* and less weight to *environment*. Unemployed respondents attached less weight to *heating/air conditioning* and to *toilet availability and cleanliness*.

6 Bus stop and train station ratings

6.1 Introduction

The second component of bus and rail service quality relates to the bus stops and train stations. To assess quality, respondents were asked to rate the bus stop or train station where they boarded. For bus, respondents were asked to rate their bus stop in terms of weather protection, seat availability and comfort, cleanliness and graffiti, lighting and information on bus times. For rail, the list was longer reflecting the greater range of facilities usually provided including staff, bus transfer and car parking.

Section 6.2 describes the rating questions and section 6.3 presents the response rates. Sections 6.4 and 6.5 provide a descriptive analysis of the ratings by city and by route. Sections 6.6 to 6.16 discuss and analyse the bus stop ratings and sections 6.17 to 6.32 do the same with the train station ratings. Section 6.33 compares the bus stop and train station ratings after placing them in rating and class order (ie bus stations, CBD and suburban stops for buses and hub, major and local stations for rail).

6.2 The rating questions

The SP survey asked respondents to provide an overall rating of the bus stop or train station where they boarded their service.

Figure 6.1 Stated preference bus stop and train station rating (five-point scale)

2. Please rate the bus stop where you got on this bus in terms of weather protection, seating, lighting and information on a 1-5 scale where 1 is very poor & 5 is very good. *Please tick one box.*

	1 Very Poor	2 Poor	3 Average	4 Good	5 Very Good
Bus Stop Rating					

2. Please rate the station where you got on this train in terms of its weather protection, seating, information, appearance, cleanliness and staff on a 1-5 scale where 1 is very poor & 5 is very good.

Please tick one box	1 Very Poor	2 Poor	3 Average	4 Good	5 Very Good
Station Rating					

The bus and train rating questions differed. The bus questionnaire asked passengers whether their bus stop had shelter, seating, a timetable and an electronic timetable. Passengers were asked to rate the bus stop on a nine-point scale in terms of weather protection, seat availability and comfort, cleanliness and graffiti, lighting, information on bus times and overall.

Figure 6.2 Bus stop rating question – nine-point scale

2. Did your bus stop have the following?

a) Shelter	1❐Yes	2❐No
b) Seating	1❐Yes	2❐No
c) A timetable	1❐Yes	2❐No
d) An electronic timetable	1❐Yes	2❐No

3. Please rate the bus stop where you got on this bus on a 1 to 9 scale where 1 is very poor and 9 is very good. *Please circle your rating or leave blank if you have no opinion.*

	Very Poor			Average			Very Good		
a) Weather protection	1	2	3	4	5	6	7	8	9
b) Seat availability and comfort	1	2	3	4	5	6	7	8	9
c) Cleanliness and graffiti	1	2	3	4	5	6	7	8	9
d) Lighting	1	2	3	4	5	6	7	8	9
e) Information on bus times	1	2	3	4	5	6	7	8	9
f) Your overall rating of the bus stop you got on this bus	1	2	3	4	5	6	7	8	9

Two rating questionnaires were developed for rail; an 'inbound' and an 'outbound' questionnaire. The inbound questionnaire asked passengers to rate the station they boarded at and the outbound questionnaire asked passengers to rate the station they would alight at.

The reason two questionnaires were developed was to get a greater range in stations rated. In the Wellington region, around 90% of rail trips begin or end at the Wellington train station. Thus on outbound Wellington trains, asking about the board station would be dominated by views on Wellington station. Asking the rating question in terms of the alight station helped capture a greater range of stations. However, if all inbound services were surveyed by an 'inbound' questionnaire and all outbound by an 'outbound' questionnaire then views on Wellington train station would never be surveyed. So surveyors were given packs of questionnaires in a ratio of 9:1 so that Wellington train station would get surveyed 10% of the time.

Figure 6.3 shows the inbound rail rating questionnaire. Before completing the rating passengers were asked how they had got to the station. This information was used to analyse the car parking and bus transfer questions. The outbound questionnaire was similar but asked passengers how they would get from the station to their destination.

6.3 Response rates and composition of the mean score

As with the vehicle rating questionnaire, the 'instructions' (refer to figures 6.2 and 6.3) asked passengers who did not have an opinion on a particular attribute to leave the space blank. Most gave a rating as can be seen in table 6.1.

Table 6.1 Response rates to the rating questions

Attribute	Bus			Rail		
	Response	Total	%	Response	Total	%
Weather protection	3,516	3,648	96%	3,413	3,553	96%
Seating	3,499	3,648	96%	3,399	3,553	96%
Platform surface	–	–	–	3,331	3,553	94%
Ease on/off platform	–	–	–	3,389	3,553	95%
Information	3,469	3,648	95%	3,353	3,553	94%
Lighting	3,300	3,648	90%	3,227	3,553	91%
Cleanliness and graffiti	3,457	3,648	95%	3,331	3,553	94%
Toilet avail and cleanliness	-	-	-	2,860	3,553	80%
Staff avail and helpfulness	-	-	-	3,046	3,553	86%
Retail facilities, eg drinks	-	-	-	2,993	3,553	84%
Ticket purchase	-	-	-	3,117	3,553	88%
Car access	-	-	-	3,127	3,553	88%
Bus access				2,855	3,553	80%
Overall rating - rating q'aire	3,479	3,648	95%	3,363	3,553	95%
Overall rating - SP q'aire	3,753	3,916	96%	1,415	1,440	98%

For bus, the highest rating was 96% for *weather protection* which was positioned at the top of the attribute list. The response rate for the *overall* rating (at the bottom of the list) was 95% in the rating questionnaire and 96% in the SP questionnaire (which only asked an overall rating). The lowest response was for *lighting* at 90% which can probably be attributed to most surveys being carried out during day time.

For rail, 98% gave an overall rating on the SP questionnaire. For the rating questionnaire, the rail response was similar to bus for ‘common’ attributes, eg 96% for *weather protection* and *seating,* 95% for the *overall* rating and 91% for *lighting*. For rail specific attributes, however, the response rate dropped into the 80% range. For *car parking and car passenger pick up and set down facilities* the response rate remained high at 88% but fell to 80% for *ease of transferring to and from bus*; the lower response attributable to a lack of relevance for passengers who walk or use a car to access their train station.

Figure 6.3 Rail inbound rating question – nine-point scale

3. How did you get to the station where you boarded this train? *Please tick one box.*

1❑ Walk all the way 2❑ Bicycle 3❑ Bus 4❑ Taxi
5❑ Car parked at station 6❑ Car dropped off at station
7❑ Another train - which station are you travelling to? ……………………………………Station
8❑ Other *Please specify*………………………………………………………………………………

4. Please rate the station where you got on this train on a 1 to 9 scale where 1 is very poor and 9 is very good. *Please circle your rating or leave blank if you have no opinion.*

	Very Poor			Average			Very Good		
a) Platform weather protection	1	2	3	4	5	6	7	8	9
b) Platform seating	1	2	3	4	5	6	7	8	9
c) Platform surface	1	2	3	4	5	6	7	8	9
d) Ease of getting to & from the platform e.g. stairs	1	2	3	4	5	6	7	8	9
e) Timetable information and station announcements	1	2	3	4	5	6	7	8	9
f) Station lighting	1	2	3	4	5	6	7	8	9
g) Station cleanliness & graffiti	1	2	3	4	5	6	7	8	9
h) Availability & cleanliness of toilets	1	2	3	4	5	6	7	8	9
i) Availability & helpfulness of staff	1	2	3	4	5	6	7	8	9
j) Ability to buy food, drinks and newspapers etc	1	2	3	4	5	6	7	8	9
k) Ease of ticket purchase	1	2	3	4	5	6	7	8	9
l) Car parking and car passenger pick up & set down facilities	1	2	3	4	5	6	7	8	9
m) Ease of transferring to & from bus	1	2	3	4	5	6	7	8	9
n) Your overall rating of the station you got on this train	1	2	3	4	5	6	7	8	9

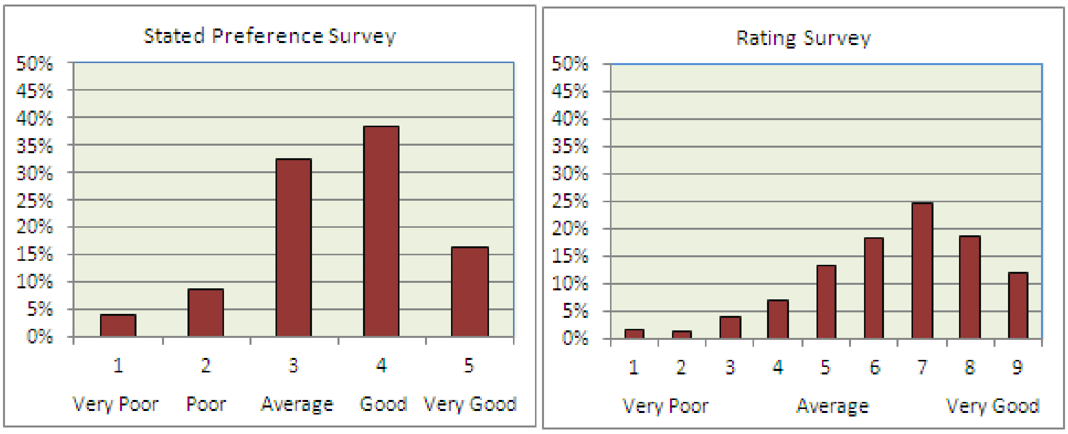
The responses to the SP (five-point scale) and the rating (nine-point scale) were converted to a percentage scale as described in section 5.3 which enabled the responses to the two different questionnaires to be pooled.

Table 6.2 and figure 6.4 compare the composition of the overall ratings for the two surveys (bus and rail response combined). As with the vehicle rating, the SP response histogram was 'taller' because it had fewer categories but the average ratings were very similar: the rating survey gave an average of 65.9% and the SP survey 65.1%. The difference was therefore less than 1%.

Table 6.2 Composition of the mean score overall stop/station rating

Label	Stated preference (5-point scale)				Rating survey (9-point scale)			
	5pt	%R	N	Percent	9pt	%R	N	Percent
Very poor	1	0%	169	3.3%	1	0%	115	1.7%
					2	13%	121	1.8%
Poor	2	25%	410	7.9%	3	25%	299	4.4%
					4	38%	567	8.3%
Average	3	50%	1,626	31.5%	5	50%	1,005	14.7%
					6	63%	1,262	18.4%
Good	4	75%	2,063	39.9%	7	75%	1,684	24.6%
					8	88%	1,094	16.0%
Very good	5	100%	900	17.4%	9	100%	695	10.2%
Total	All	na	5,168	100%	All	na	6,842	100%
Av rating (AvR%)	65.1%				65.9%			

Figure 6.4 Composition of the overall stop/station rating



6.4 Overall bus stop and train stations by city and survey type

Although, the two surveys gave very similar overall ratings, there were differences when the bus stop and train station ratings were analysed separately. The rating survey gave a score of 68% for bus stops and 64% for train stations, whereas the SP survey gave an average bus stop rating of 64% and an average train station rating of 69%. The differences were relatively small, however, at less than 5% points. Table 6.3 and figure 6.5 present the average ratings and figure 6.6 shows the distribution of responses across the rating categories.

When the rating and SP surveys were combined, there was very little difference in the bus stop and train station ratings. Bus stops averaged 66% and train stations 65%. Thus, despite typically much greater investment in train stations, the average passenger rating was no higher than for bus stops.

Across the cities, Auckland bus stops averaged 67%, Wellington 66% and Christchurch 63%. The effect of the Christchurch earthquake (which caused the closure of the bus exchange and required the opening of an open air central exchange) should be considered here.

The train station ratings were similar for Auckland and Wellington at 67% and 64% respectively.

As subsequent analysis will show, there was a wide range in the ratings of the individual bus stops and train stations reflecting the quality of the facilities available.

Table 6.3 Overall bus stop and train station ratings by city and survey type

Mean bus stop/train station overall rating %								
Survey	**CHC bus**	**WTN bus**	**AUC bus**	**All bus**	**WTN rail**	**AUC rail**	**All rail**	**All**
Rating	65%	68%	69%	68%	63%	66%	64%	66%
SP	61%	64%	65%	64%	69%	69%	69%	65%
All	63%	66%	67%	66%	64%	67%	65%	66%
Standard deviation (%)								
Survey	**CHC bus**	**WTN bus**	**AUC bus**	**All bus**	**WTN rail**	**AUC rail**	**All rail**	**All**
Rating	25%	20%	23%	23%	23%	22%	23%	23%
SP	27%	25%	24%	25%	22%	24%	22%	24%
All	26%	23%	24%	24%	23%	22%	23%	23%
Sample size (N)								
Survey	**CHC bus**	**WTN bus**	**AUC bus**	**All bus**	**WTN rail**	**AUC rail**	**All rail**	**All**
Rating	563	1,189	1,727	3,479	2,238	1,125	3,363	6,842
SP	728	1,218	1,807	3,753	1,065	350	1,415	5,168
All	1,291	2,407	3,534	7,232	3,303	1,475	4,778	12,010
Standard error (%)								
Survey	**CHC bus**	**WTN bus**	**AUC bus**	**All bus**	**WTN rail**	**AUC rail**	**All rail**	**All**
Rating	1.1%	0.6%	0.6%	0.4%	0.5%	0.7%	0.4%	0.3%
SP	1.0%	0.7%	0.6%	0.4%	0.7%	1.3%	0.6%	0.3%
All	0.7%	0.5%	0.4%	0.3%	0.4%	0.6%	0.3%	0.2%

Figure 6.5 Overall bus stop and train station ratings by city

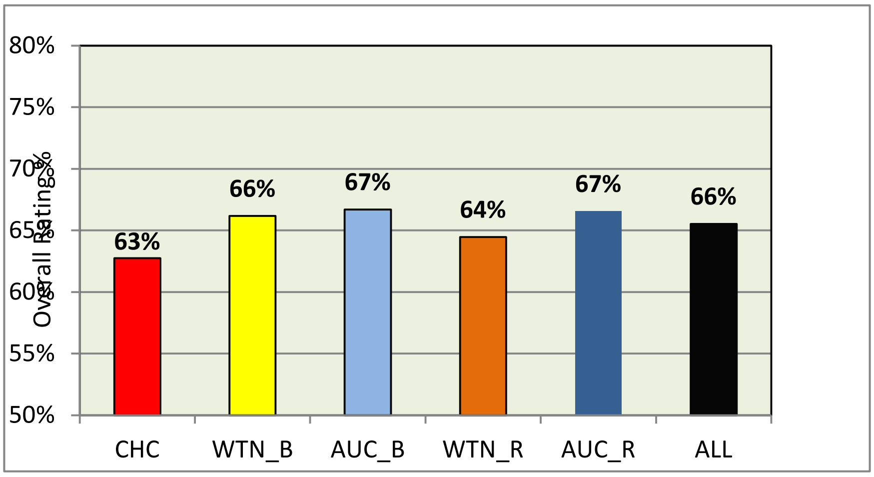
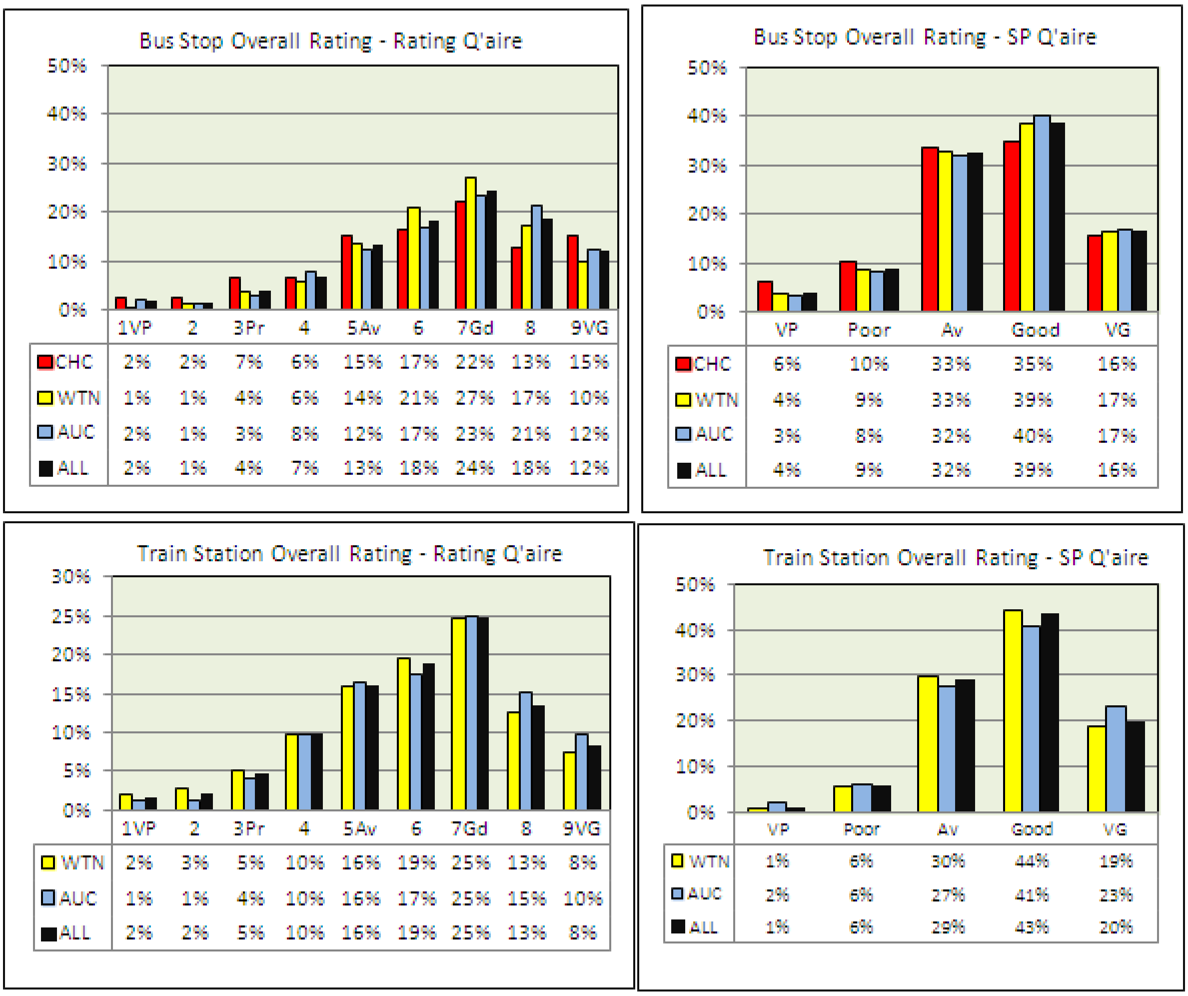


Figure 6.6 Profile of the bus stop and train station ratings by city and survey



Bus Stop Overall Rating - Rating Q'aire

	1VP	2	3Pr	4	5Av	6	7Gd	8	9VG
CHC	2%	2%	7%	6%	15%	17%	22%	13%	15%
WTN	1%	1%	4%	6%	14%	21%	27%	17%	10%
AUC	2%	1%	3%	8%	12%	17%	23%	21%	12%
ALL	2%	1%	4%	7%	13%	18%	24%	18%	12%

Bus Stop Overall Rating - SP Q'aire

	VP	Poor	Av	Good	VG
CHC	6%	10%	33%	35%	16%
WTN	4%	9%	33%	39%	17%
AUC	3%	8%	32%	40%	17%
ALL	4%	9%	32%	39%	16%

Train Station Overall Rating - Rating Q'aire

	1VP	2	3Pr	4	5Av	6	7Gd	8	9VG
WTN	2%	3%	5%	10%	16%	19%	25%	13%	8%
AUC	1%	1%	4%	10%	16%	17%	25%	15%	10%
ALL	2%	2%	5%	10%	16%	19%	25%	13%	8%

Train Station Overall Rating - SP Q'aire

	VP	Poor	Av	Good	VG
WTN	1%	6%	30%	44%	19%
AUC	2%	6%	27%	41%	23%
ALL	1%	6%	29%	43%	20%

6.5 Bus stop and train station ratings by aggregated route

A limited analysis was provided by aggregated route to complement the analysis of vehicle ratings although most of the analysis was undertaken by aggregated bus stop or train station.

Figure 6.7 graphs the overall rating by aggregated route (with the standard error range also shown) A detailed tabulation of the overall rating and the individual attribute ratings is provided in appendix D, table D.2 (see part 3 of this report).

The overall rating of Christchurch bus stops averaged 62% to 63% with little variation across the aggregated routes. For Wellington bus, the rating ranged from 63% on the Hutt Valley (WB9) and Johnsonville/Churton Park (WB10) routes to 71% on the Newtown, Island Bay and Happy Valley bus service (WB1).[45]

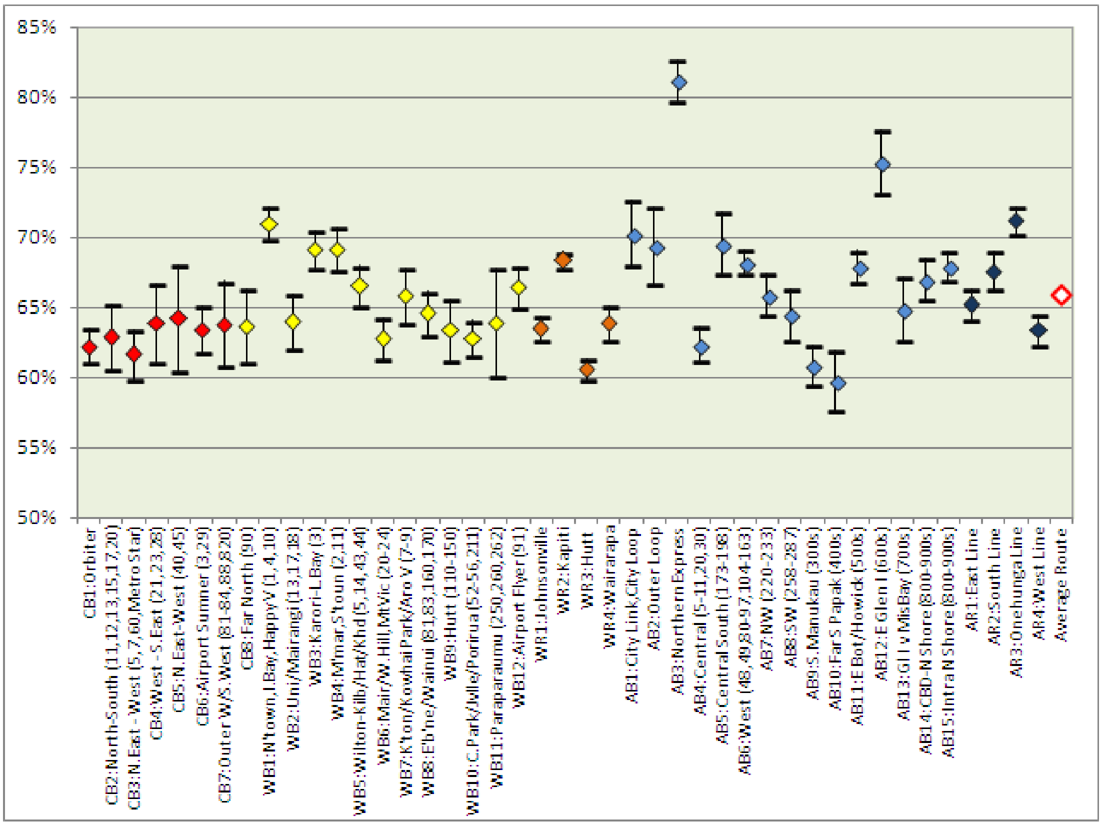
The rating of Wellington train stations varied from 61% on the Hutt Valley line to 67% on the Kapiti line.

[45] Detailed tabulations are provided in appendix E. Maps of the Christchurch and Auckland bus routes are provided in appendices F and G (see part 3 of this report).

There was a wider range in the rating of Auckland bus stops. The lowest rating was 60% on South Auckland bus routes (AB9 and AB10) and the highest was 81% on the Northern Express where new bus stations have been built at Albany and Akoranga. Also rated highly at 75% were bus stops on the Glen Innes bus route (AB12) and the Link and Loop services (AB1 and AB2) which scored 70%.

Auckland train stations tended to be rated higher than Wellington stations probably reflective of the extensive upgrade programme that has taken place on the Auckland network. The overall rating ranged from 63% on the West line to 71% on the Onehunga line.

Figure 6.7 Overall stop and station ratings by aggregated route



It should be remembered that the aggregated route ratings reflect the sampling of the bus stops. As subsequent sections will show, bus stations tended to rate higher than city centre stops which in turn rated higher than suburban bus stops.

6.6 Photos of bus stops in Christchurch, Wellington and Auckland

The survey covered a range of bus stops, from the most basic street bus stop without shelter or seating to major interchange stations in Christchurch, Wellington and Auckland where a full range of passenger facilities are usually provided. The following photographs help describe the range of bus stops that were surveyed.

6.6.1 Christchurch bus stops

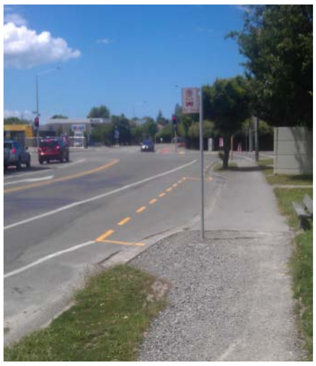
Four bus stops featuring the typical bus stop information sign. The two on the left have no seating or shelter. The third from the left near the Riccarton mall has seating. The right photo is of the Christchurch Bus Exchange which replaced the earthquake damaged bus terminal. Outer photos provided by ECAN and the middle two by JF.

Bus stops on Maidstone road in central Christchurch. On the left, a sign and timetable mounted on a tree. In the middle, a shelter with a timetable and on the right a bus stop sign on a verge (JF). The facilities often reflect the side of the road where most passengers board (the other side of the road being where they alight).

On the left a bus stop with shelter on the main south road opposite Riccarton school. In the middle and right, a bus shelter with advertising on the sides of the shelter at the corner of Weaver Place and Main South Road. (JF)

Three bus stops on Ilam Road with seating and shelter and an electronic display (JF)

Two bus stops on Ilam Road. On the left, new pavement is being installed at a bus stop and on the right, the advertising hoarding is on the downside and does not obstruct views of buses. (JF)



Two bus stops on Maidstone Road. On the left, a bus stop with shelter and shaded by trees. On the right a bus stop with seating but no shelter and no timetable. (JF)

6.6.2 Wellington bus stops

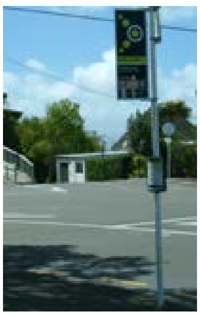
A Wellington bus station where stops have shelter, seating, electronic and standard timetable information. (FX

Lambton Quay - Wellington's premier street. The bus stop has general information and seating with shelter under shop verandas. (NJD)

A new Molesworth St bus stop near Parliament with shelter, seating, rubbish bin and nearby electronic timetable. (FX)

Willis St bus stop with no seating. Shelter is provided by nearby shop verandas. The timetable has slid to the ground. (NJD

The left and centre photos show bus stops on Lambton Quay. Both have seating and one has a shelter. The photo on the right is a bus stop on Willis Street which has no seating. Weather protection is provided by nearby shop verandas. (NJD)



Four nearby bus stops on Northland Road with a stop sign and timetable on the left to a new shelter on the right. The middle two bus stops are older wooden and concrete shelters with poor inside visibility. (NJD)


Queensgate bus stops outside the shopping mall in Lower Hutt city centre. (NJD)


Bus stops outside Upper Hutt railway station. (NJD)


A bus stop outside Waterloo Interchange has shelter, seating and a timetable but the glass and paint work inside are in a shabby state. (NJD)



Two bus stops in Naenae Lower Hutt. On the left, a wooden shelter with a mesh grill but some 'ghosting' graffiti. On the right, a new shelter with glass sides and advertising. (NJD)


A bus stop at the intersection of Houghton Bay and the Esplanade. The stop is at the end of the route and has no timetable, shelter or seating. The 'shed' is a toilet for bus drivers.


A bus stop on the Esplanade with no timetable.



Two bus stops on opposite sides of Glenmore St near the Botanical Gardens. The bus stop on the left has electronic information but no shelter. The bus stop on the right has a new shelter and seating. (NJD)


A new glass bus stop is shown outside Wellington Hospital in Newtown. The stop has full facilities. (ND)




Bus stops in Churton Park were not highly rated. The left and centre photos show a bus stop on a grass bank with no footpath. On the right is a bus stop in Raroa Rd next to a school. It has a reasonable standing area but no seating or shelter. (NJD)



Churton Park and nearby Grenada village have a range of bus stops with shelters ranging from a glass design on the left to a wooden/metal grill design in the centre and an aluminium shelter on the right. (NJD)

6.6.3 Auckland bus stops

Albany bus station on the North Shore served by the Northern Express (NZ Transport Agency). The Northern Express bus stations were highly rated by passengers.

Akoranga bus station served by the Northern Express (DW). A ticket machine and information display can be seen in this photo. There is also an ATM and drinks vending machine.



At the Auckland city centre end of the Northern Express (DW), the bus stops are ‘street’ stops. The stop shown in the middle photo is near Britomart and has an RTI display. (C

Britomart bus stop at the centre end of the Northern Express. (DW)

Auckland Airport bus stop. (DW)

Three suburban bus stops. The left photo at 22 Cavendish Drive has shelter, seating and a timetable (not shown). The centre photo at 123 Queens Road Panmure has an electronic sign and mesh seating. On the right, 52 Mayfair Place Glen Innes has full facilities but despite the rubbish bin there are lots of cigarette butts and bubble gum stuck on the ground. (CH)

The bus stop on the left is at 48 St George St Papatoetoe and has seating facing away from the road under a shop veranda. The middle photo is at 21 Shirley Road Papatoetoe next to the train station and is the bus stop for 380 airport bus. It has shelter and seating and an electronic display board which is not shown. The stop on the right is at 313 Great South Road Papatoetoe and has shelter and seating but is not totally covered from rain when windy. The bus stop has a timetable but no electronic display board. (CH)

Two photos of the bus stop at near Westfield train station and shopping mall. The stop has shelter, seating, electronic and standard timetable information and is in a very good condition. (CH)

Two photos of the bus stop at 24 Millhouse Drive Northpark in the eastern suburbs of Auckland. The bus stop has shelter and new wooden seating. The glass is spotless and the shelter is in excellent condition. The stop has a timetable on a pole but no electronic display board. (CH)

6.7 Bus stop facilities

The bus rating questionnaire asked whether a shelter, seating, timetable and RTI electronic displays were provided at the respondent's boarding stop. This section discusses the percentage of respondents who considered such facilities were provided at their stop. The statistics are therefore based on the perceptions of passengers and not what may have been actually provided.

In terms of timetable provision, 86% considered there was one at their bus stop with the percentage ranging from 80% in Christchurch to 90% in Wellington. For RTI, the percentage fell to 55%, ranging from 44% in Wellington to 64% in Auckland.

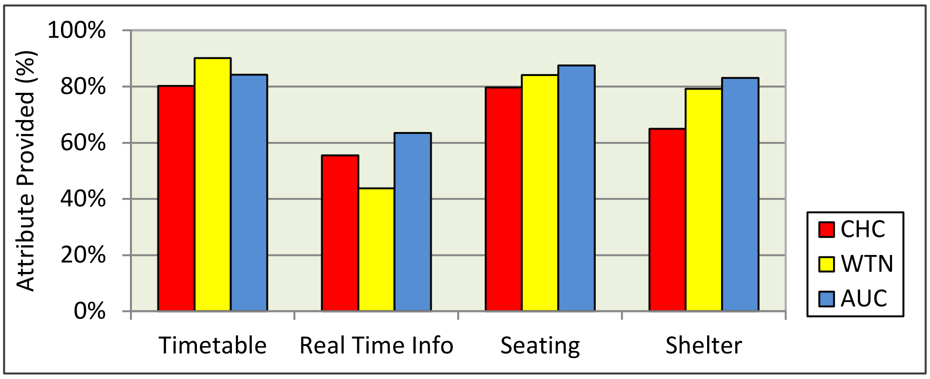
In terms of seating, 85% responded that seating was provided at their bus stop with the percentage varying from 80% in Christchurch to 87% in Auckland.

Fewer respondents (79% overall) considered that shelter was provided at their stop with the lowest percentage in Christchurch (65%) and the highest in Auckland (83%).

Table 6.4 Perceived availability of bus stop facilities

	Number of Respondents				Percent of Respondents			
Attribute	CHC	WTN	AUC	ALL	CHC	WTN	AUC	ALL
Timetable	441	1,062	1,440	2,943	80%	90%	84%	86%
Real Time Info	305	515	1,087	1,907	55%	44%	64%	55%
Seating	438	991	1,497	2,926	80%	84%	87%	85%
Shelter	357	933	1,421	2,711	65%	79%	83%	79%
Total	550	1,178	1,711	3,439	100%	100%	100%	100%

Figure 6.8 Perceived availability of bus stop facilities by city



Given there were four attributes and each attribute could be either available or not available, the total number of attribute 'combinations' was 16. Table 6.5 and figure 6.9 present a response profile for each city which was calculated as the percentage of total valid responses for each of the combinations.

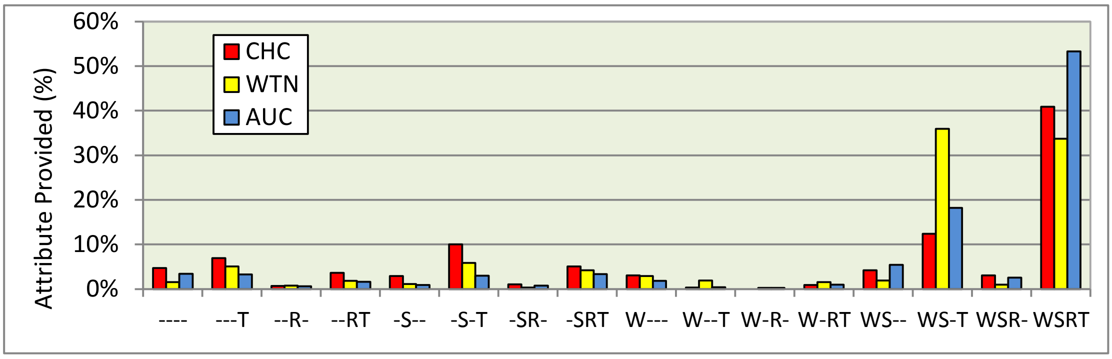
Three percent of respondents said their bus stop had no facilities (----). The percentage was highest in Christchurch (5%) and lowest in Wellington (2%).

Four percent responded there was only a timetable (---T) and 1% only RTI (--R-). Two percent said there was a timetable and RTI (--RT). Thus in total, 7% responded that information was provided at their bus stop but that seating and shelter were not provided.

Table 6.5 Perceived 'combined' bus stop facility availability by city

#	Attribute	Number of respondents				Percent of respondents			
		CHC	WTN	AUC	ALL	CHC	WTN	AUC	ALL
1	----	26	18	59	103	5%	2%	3%	3%
2	---T	38	60	56	154	7%	5%	3%	4%
3	--R-	4	9	11	24	1%	1%	1%	1%
4	--RT	20	22	28	70	4%	2%	2%	2%
5	-S--	16	13	15	44	3%	1%	1%	1%
6	-S-T	55	69	51	175	10%	6%	3%	5%
7	-SR-	6	4	13	23	1%	0%	1%	1%
8	-SRT	28	50	57	135	5%	4%	3%	4%
9	W---	17	34	31	82	3%	3%	2%	2%
10	W--T	2	23	7	32	0%	2%	0%	1%
11	W-R-	0	3	5	8	0%	0%	0%	0%
12	W-RT	5	18	17	40	1%	2%	1%	1%
13	WS--	23	23	93	139	4%	2%	5%	4%
14	WS-T	68	423	312	803	12%	36%	18%	23%
15	WSR-	17	12	44	73	3%	1%	3%	2%
16	WSRT	225	397	912	1,534	41%	34%	53%	45%
-	Total	550	1,178	1,711	3,439	100%	100%	100%	100%

Figure 6.9 Perceived 'combined' bus stop facility by city



The perceptions of respondents were that the percentage of stops without a timetable was higher than 'fieldwork' suggested. Only two Wellington bus stops out of about 80 that were inspected as part of taking photographs had no timetable and one of these was at the end of a route where no one would board. Thus bus stops without timetables were rare in Wellington (2.5%). In some cases, an electronic display was provided rather than a 'paper' timetable. When RTI was taken into account, the percentage of Wellington respondents who said there was no timetable at their stop was 7%. In Auckland it was 12% and in Christchurch it was 15%. Future analysis could seek to correlate passenger perceptions, as presented here, with actuality.

Only 1% of respondents said only seating was provided at their stop. Ten percent responded that seating and information (combinations 6, 7 and 8) were provided, with the highest percentage in Christchurch (16%) and the lowest in Auckland (7%).

Two percent replied that only shelter (W) was provided. The response was similar to the 80 respondents who said shelter and information were provided but no seating (10, 11 and 12).

The majority of respondents, 70% for the three cities combined, said both seating and shelter were provided at their stop (13–16). The percentage was lower in Christchurch at 61% and highest in Auckland at 80%.

The largest percentage for any one of the 16 combinations was 45% for the full provision of all four attributes (WSRT). The percentage ranged from 34% in Wellington to 53% in Auckland.

6.8 Bus stop rating and facilities provided

The bus stop ratings were compared with respondents' perceptions of the facilities provided. The relationships were estimated for the aggregated bus stops where there were at least 10 responses.

Table 6.6 provides a summary. A detailed response by aggregated bus stop is provided in appendix E (see part 3 of this report)[46] covering shelter, seating and information, cleanliness and graffiti, lighting and the overall rating.

There was a wide range in attribute provision and rating. For Christchurch, the availability of a shelter ranged from 10% in Addington to 93% in Shirley with the rating ranging from 13% in Addington to 76% at the Christchurch bus exchange.

There was a general correlation in rating and availability. The Christchurch bus exchange had high attribute availability and high ratings. For Sumner, all respondents said timetables were provided at their stop and information was rated relatively highly at 72%. Conversely, where shelter and seating were not available as at Addington, the ratings were lower.

In Wellington, all respondents who used the Queensgate bus stop in Lower Hutt said seating and shelter were provided. Their ratings were high at 74% and 65% but were exceeded by the shelter rating at Courtenay Place (77%) and the seat rating of 69% at Upper Hutt. At the bottom end of the scale, Churton Park had low availability of facilities and low ratings. Bus stops in Melrose and Brooklyn also received low ratings.

In Auckland, the new bus station at Albany (see photograph in section 6.6.3) on the Northern Expressway rated highly scoring 80% overall. In fact, Albany was the highest rated station in the survey just beating Newmarket train station which scored 79%. Wellington Interchange scored 75% and Christchurch bus exchange 74%. Glen Innes had the highest shelter provision (100%) and Karangahape Road in Auckland city the highest seat provision (100%), both of these ahead of Albany. At the other end of the scale, Newmarket, Remuera and Parnell had low shelter seating availability and rated lowly. In terms of the overall rating, Mt Roskill rated the lowest with a score of 50%.

[46] Table E.3 describes the make-up of each aggregated bus stop.

Table 6.6 Perceived 'combined' bus stop facility by city

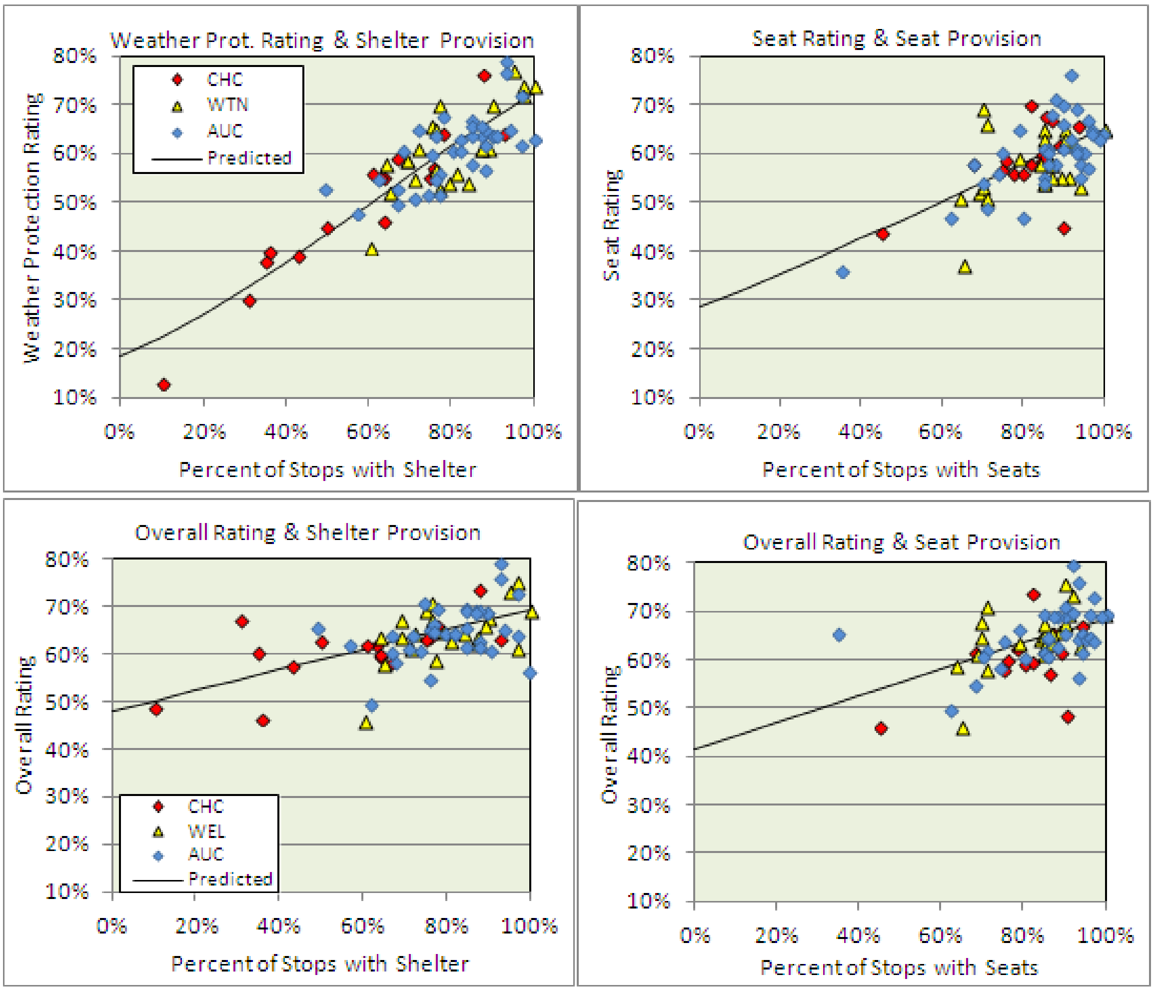
	Shelter		Seating		Information			Rating R%		
	Prov?	R%	Prov?	R%	TT?	RTI?	R%	C&G	Lght	All
Christchurch										
Maximum	93%	76%	94%	70%	100%	72%	72%	82%	77%	74%
Bus stop	Shirley	CHC exchange	Cashiel – B'ham	CHC exchange	Sumner	Papanui-M'vale	Sumner	CHC exchange	Walth'm - Opawa	CHC exchange
Average	58%	50%	80%	59%	81%	49%	59%	66%	55%	61%
Minimum	10%	13%	45%	44%	58%	0%	47%	44%	31%	46%
Bus stop	Adding-ton	Addington	BfNCtRd	BfNCtRd	Syd'ham-Sp'rydon	Adding-ton	Linwood - P'town	BfNCtRd	Adding-ton	BfNCtRd
Wellington										
Max	100%	77%	100%	69%	100%	100%	79%	86%	77%	75%
Bus stop	Queens-gate	C'rtenay Place	Queens-gate	Upper Hutt	Churton Park	Queens-gate	WTN IC	WTN IC	WTN IC	WTN IC
Average	80%	61%	82%	57%	89%	46%	67%	73%	60%	65%
Minimum	60%	41%	64%	37%	64%	5%	47%	49%	39%	46%
Bus stop	Churton Park	Churton Park	Brooklyn Melrose	Churton Park	Brooklyn Melrose	Churton Park	Queens-gate	Brooklyn Melrose	SVTTSil	Churton Park
Auckland										
Maximum	100%	79%	100%	76%	100%	93%	81%	81%	77%	80%
Bus stop	Glen Innes	Albany	K'Rd	Albany	Custom St	K'Rd	Albany	Pak'rnga-BotDwns	Albany	Albany
Average	81%	61%	86%	60%	82%	56%	69%	67%	62%	65%
Minimum	49%	48%	35%	36%	53%	18%	47%	45%	41%	50%
Bus stop	Nwkt RemPar	Howick	Nwkt RemPar	Nwkt RemPar	Panmure Mt Wel	BlckBy Titangi	Otahuhu .E.Tam	Epsom GrnLane	TeAtatu	Mt Roskill

Figure 6.10 presents scattergrams of provision versus rating for shelter and seating. Similarly figure 6.11 presents the relationship for information. Table 6.7 presents the regression models (which used logistic functions to keep the predictions within 0% and 100% although as can be seen, the 'curves' were close to straight lines).

The strongest relationship was between the weather protection rating and the provision of shelter. The lowest provision percentage was in Christchurch (the red diamonds) and these bus stops had the lowest ratings with the predicted ratings close to the observed. As an example, 45% of Burnside – Bishopdale bus stop users said there was a shelter at their stop and rated weather protection at 39%. The predicted rating was also 39% using the estimated constant of α of -1.49 and the β parameter of 2.44 shown in table 6.7. The relationship was weaker for the overall rating and shelter provision which is reflected in the flatter curve (with predicted ratings ranging from 50% to 70%) and a wider spread in observations around the fitted line.

The rating of seat provision was less predictable with a range from 30% to 65%. In part, this reflected high seat provision ranging from 80% to 100%. The overall rating was less strongly correlated with seating provision with the predictions ranging from 40% to 70%.

Figure 6.10 Bus stop rating with weather protection and seating provision



The relationship between the information rating and the provision timetables/RTI was weak which can be seen by the wide spread in the observed ratings. Respondents presumably rated the quality of information (ie the buses' adherence to their timetable) rather than the presence of a timetable. For RTI, some respondents may have considered that the information displayed did not match reality.

Somewhat counter-intuitive was a stronger relationship between information provision (both timetable and RTI) and the overall rating. The increase in strength was particularly strong for RTI with the predicted rating increasing from 58% to 72% compared with the nearly flat relationship for the information rating. The stronger overall rating relationship probably resulted from RTI provision at 'bigger' bus stops which also have seating, shelter and good lighting.

Figure 6.11 Bus stop rating with information provision

Table 6.7 Models of bus stop ratings with facility provision

Rating	Attribute provision	Estimate		Std error		|t| Value	
		α	β	α	β	α	β
Weather prot	Weather prot	-1.49	2.44	0.13	0.17	11.4	14.6
Overall	Weather prot	-0.09	0.89	0.12	0.15	0.7	5.8
Seating	Seating	-0.91	1.53	0.21	0.25	4.4	6.2
Overall	Seating	-0.35	1.12	0.20	0.23	1.8	4.8
Information	Timetable	0.19	0.61	0.37	0.44	0.5	1.4
Information	Real-time info	0.53	0.32	0.11	0.19	5.0	1.7
Overall	Timetable	0.01	0.69	0.25	0.29	0.0	2.4
Overall	Real-time info	0.26	0.63	0.06	0.11	4.3	5.9

Models fitted on 75 aggregated bus stop observations.

ln(R%/(1-R%)) = α +β(ATT%) where ATT% = percent considering attribute available.

6.9 Bus stop rating and waiting time

The survey asked passengers how long they waited for their bus. The response enabled the ratings to be compared with wait time. Relationships could result from either response 'colouring' (with longer waits inducing passengers to rate their bus stop worse) or reflect 'planners' putting more/better facilities at bus stops with a higher bus service frequency. In both cases, the expectation was for the bus stop rating to decline as waiting time increased.

Figure 6.12 presents the relationship and table 6.8 the parameters for the fitted logistic regression model. The relationship was weakly negative with the overall rating declining from 68% at a one-minute frequency to 60% at a 20-minute frequency. The scattergram shows a concentration of observations in the 5 to 10-minute wait time band with Christchurch and Wellington falling in or close to this wait time interval. For Auckland, the spread of wait times was much wider with wait times varying from 2 to 20 minutes. Thus, the estimated relationship was largely determined by the Auckland observations.

Figure 6.12 Overall bus stop rating and waiting time

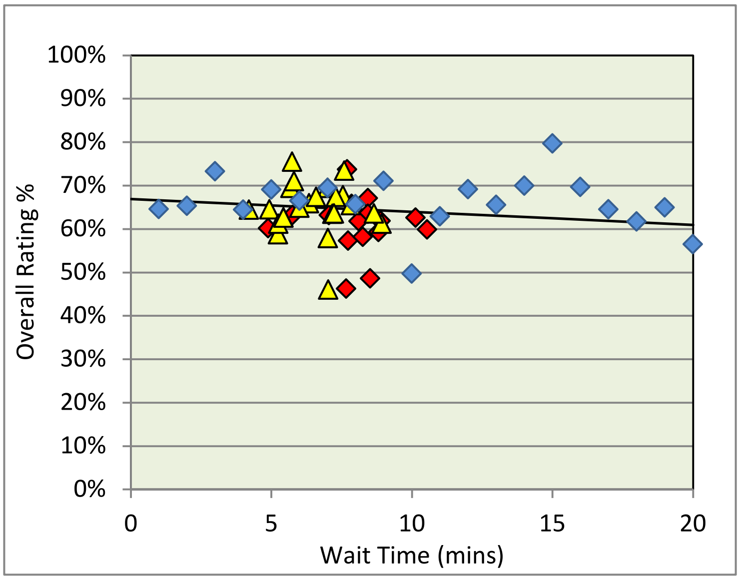


Table 6.8 Overall bus stop rating and waiting time

Parameter	Estimate		Std error		|t| Value	
	α	β	α	β	α	β
Wait time (mins)	0.70	-0.01	0.11	0.01	6.55	1.13

Models fitted on 75 aggregated bus stop observations.

$\ln(R\%/(1-R\%)) = \alpha + \beta(WAIT)$ where WAIT is the average waiting time in minutes.

6.10 Disaggregate bus stop rating and facilities model

Building on the single variable models, a 'full' model was fitted that explained the overall bus stop ratings in terms of the provision of shelter, seating, timetable information, RTI and waiting time. Rather than fit the model on the average percentages for the 75 aggregated bus stops, the model was fitted using disaggregate modelling on the individual response data; this provided 3,439 observations (where passengers had completed all questions on facility provision and waiting time).

The model parameters are presented in table 6.9 for linear and logit models. The linear model is the easiet to interpret. The constant at 0.491 means that with (theoretically) zero wait times, the rating for a bus stop with no facilities would be close to 50%. If passengers waited for 10 minutes, the predicted rating of the bus stop quality would drop by 2% points.

A shelter added 14% points to the rating, seat provision 4%, a timetable 6% and RTI 3% so that with all facilities provided, the rating would increase 27% points.

Other models were tested that included additional ‘interaction effects’ such as an expected negative effect from providing a timetable and RTI but none of the interaction terms were statistically significant.

Table 6.9 Disaggregate bus stop rating and facilities model

Variable	Linear model			Logit model		
	Parameter	STE	|t|	Parameter	STE	|t|
Constant	0.491	0.012	40.6	-0.052	0.066	0.8
Shelter provision (0,1)	0.141	0.010	14.1	0.614	0.046	13.5
Seat provision (0,1)	0.044	0.012	3.7	0.187	0.058	3.2
Real-time information (0,1)	0.034	0.011	3.1	0.294	0.057	5.2
Timetable (0,1)	0.062	0.008	8.2	0.15	0.045	3.3
Wait time (mins)	-0.0025	0.000	6.2	-0.0113	0.002	5.4

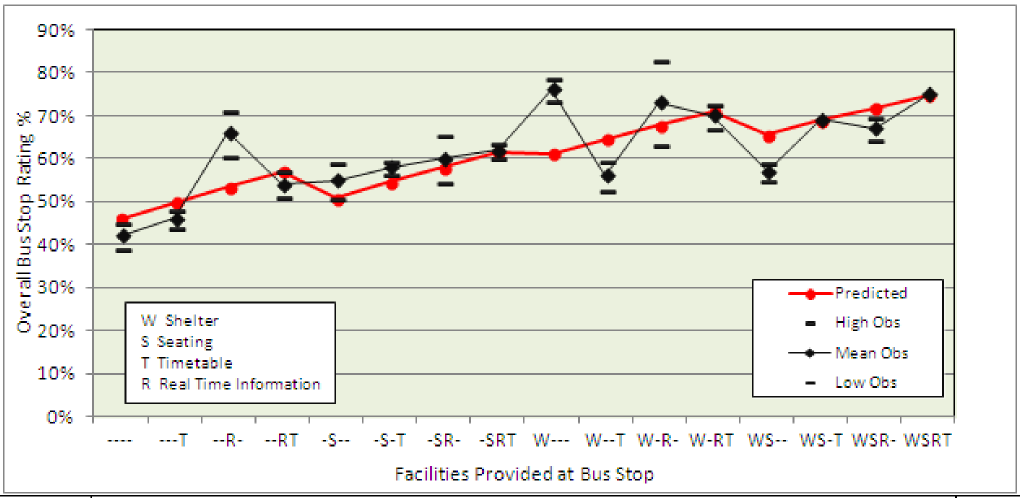
Estimated on 3,479 observations.

Figure 6.13 uses the estimated parameters to predict the rating for the 16 attribute combinations (available or unavailable). The graph shows the average and also the standard error in the observed ratings. The red line plots the predicted values.

At zero and full provision, the model gave a close fit; with no facilities (----), the predicted rating was 46% (4% points higher than the observed) and with full facilities, the predicted 75% rating exactly matched the observed rating.

For the other 14 combinations, the predicted rating generally tracked the observed values but lay outside the observed range (± one standard error) for some combinations.

Figure 6.13 Overall bus stop rating model



Facs	----	---T	--R-	--RT	-S--	-S-T	-SR-	-SRT	W---	W--T	W-R-	W-RT	WS--	WS-T	WSR-	WSRT	ALL
Mean R%	42%	46%	66%	54%	55%	58%	60%	62%	76%	56%	73%	70%	57%	69%	67%	75%	68%
StDev	31%	26%	26%	25%	28%	21%	26%	20%	23%	19%	28%	18%	24%	19%	22%	19%	23%
StErr	3%	2%	5%	3%	4%	2%	5%	2%	3%	3%	10%	3%	2%	1%	3%	0%	0%
Pred R%	46%	50%	53%	57%	51%	55%	58%	62%	61%	65%	68%	71%	66%	69%	72%	75%	68%
N	103	154	24	70	44	175	23	135	82	32	8	40	139	803	73	1,534	3,439
%	3%	4%	1%	2%	1%	5%	1%	4%	2%	1%	0%	1%	4%	23%	2%	45%	100%

6.11 Effect of passenger and trip profile on bus stop ratings

The bus stop ratings were assessed by time of travel, journey purpose, gender, socio-economic status, age group and frequency of use. Sections 6.11.1 to 6.11.11 present the different segmentations.

6.11.1 Time period

Bus users surveyed in the evening tended to rate higher and respondents surveyed in the off-peak lower than those surveyed in the AM and PM peak although there was only a 2% point range in the overall rating.

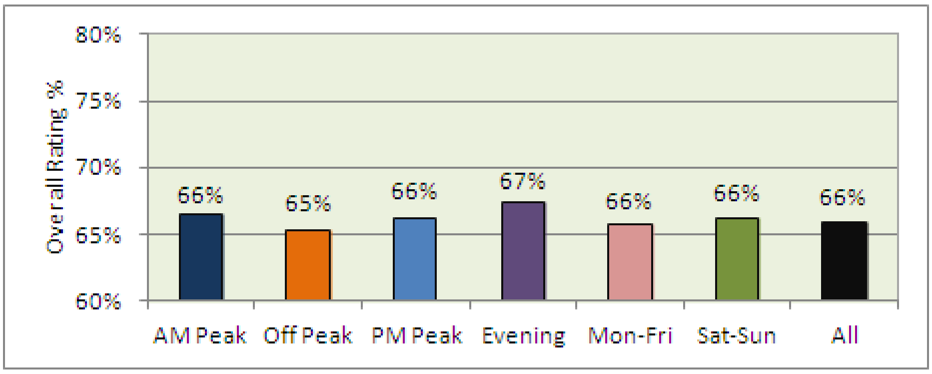
The range at 6% points was greatest for shelter with evening respondents rating higher than off-peak respondents.

There was no difference in the overall rating for weekday and weekend respondents with only small differences by attribute.

Table 6.10 Bus stop attribute ratings by time period

Time Period	Rating (%)						Sample Size	
	Shelter	Seating	Info	Lighting	Clean/Graf	All	Shelter	All
AM Peak	61%	62%	69%	62%	71%	66%	530	1,171
Off Peak	60%	59%	66%	62%	70%	65%	2,095	4,150
PM Peak	65%	59%	70%	66%	71%	66%	605	1,289
Evening	66%	64%	71%	67%	72%	67%	279	622
Mon-Fri	61%	60%	68%	63%	71%	66%	2,907	6,096
Sat-Sun	63%	61%	68%	63%	70%	66%	602	1,136
All	62%	60%	68%	63%	71%	66%	3,509	7,232
High	EV	EV	EV	EV	EV	EV	na	na
Low	OP	OP	OP	AM	OP	OP	na	na
Range	6%	5%	5%	5%	2%	2%	na	na

Figure 6.14 Bus stop attribute rating by time period



6.11.2 Trip purpose

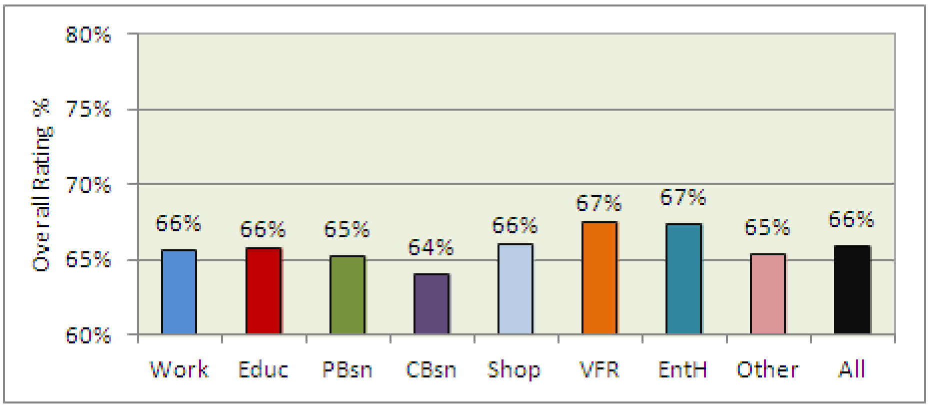
Trip purpose had little effect on the overall bus stop rating. The lowest rating was 64% for company business trips and the highest was 67% for visiting friends and relatives.

There was greater range in the attribute ratings especially information which varied from 64% for ‘other’ trips to 74% for company business with the latter probably picking up a greater percentage of respondents rating bus stations or city centre stops.

Table 6.11 Bus stop attribute ratings by journey purpose

Trip Purpose	Rating (%)						Sample Size	
	Shelter	Seating	Info	Lighting	Clean/Graf	All	Shelter	All
to/from Work	63%	60%	70%	66%	71%	66%	1,273	2,692
to/from Education	60%	56%	66%	58%	69%	66%	703	1,479
Pers Business	61%	62%	67%	65%	72%	65%	424	859
Comp Business	57%	56%	74%	67%	65%	64%	28	74
Shopping	62%	63%	67%	64%	71%	66%	426	769
Visit Friends/Rels	62%	62%	67%	61%	74%	67%	283	609
Ent/Hol/Sport	63%	62%	65%	63%	71%	67%	238	484
Other	59%	56%	64%	59%	69%	65%	67	127
All	62%	60%	68%	63%	71%	66%	3,449	7,108
High	Work	Shop	CBsn	CBsn	VFR	VFR	na	na
Low	CBsn	Other	Other	Educ	CBsn	CBsn	na	na
Range	6%	7%	10%	9%	9%	3%	na	na

Figure 6.15 Overall bus stop rating by journey purpose



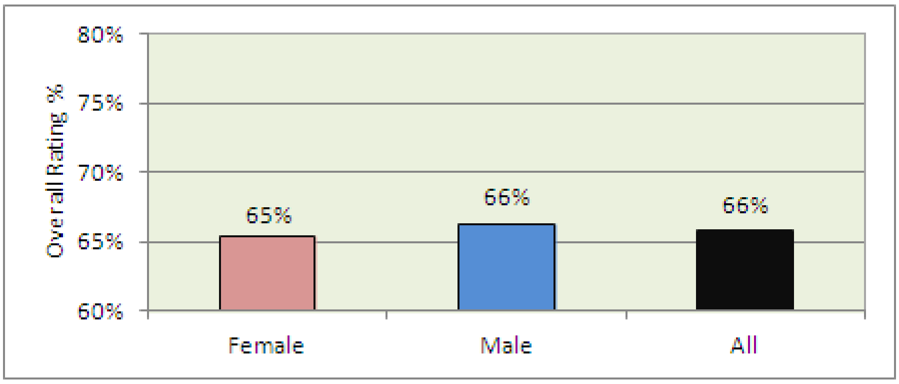
6.11.3 Gender

Males and females rated bus stops similarly with little difference in the overall rating (males rated at 66% and females 1% lower at 65%). The greatest difference was for shelter with males rating 3% higher than females.

Table 6.12 Bus stop attribute ratings by gender

	Rating (%)							
Gender	Shelter	Seating	Info	Lighting	Clean/Graf	All	Shelter	All
Female	60%	60%	67%	62%	71%	65%	1,957	4,056
Male	63%	60%	69%	64%	70%	66%	1,401	2,984
All	62%	60%	68%	63%	71%	66%	3,358	7,040
Max	Male	Male	Male	Male	Female	Male	na	na
Range	3%	0%	2%	2%	1%	1%	na	na

Figure 6.16 Bus stop attribute ratings by gender



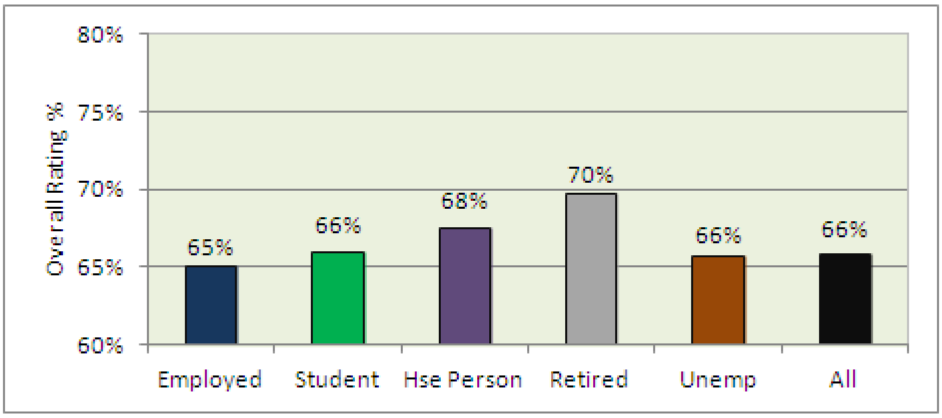
6.11.4 Socio-economic status

Consistent with the vehicle ratings, retired passengers tended to rate the highest (70% overall). House persons were next highest (68%) followed by employed respondents, students and unemployed respondents (65% to 66%). The range in rating was greatest for *lighting* and *seating* with retired passengers rating these attributes at 69% to 71% and students around 57% to 58%.

Table 6.13 Bus stop ratings by socio-economic status

Socio-Econ Status	Rating (%)						Sample Size	
	OSAp	Seating	Info	Lighting	Clean/Graf	All	OSAp	All
Employed	62%	60%	69%	65%	71%	65%	1,613	3,509
Student	61%	57%	67%	58%	69%	66%	1,249	2,592
Hse Person	61%	62%	63%	65%	69%	68%	102	229
Retired	64%	69%	70%	71%	77%	70%	290	480
Unemp	54%	63%	66%	65%	68%	66%	97	230
All	62%	60%	68%	63%	71%	66%	3,351	7,040
High	Ret	Ret	Ret	Ret	Ret	Ret	na	na
Low	UnE	Std	HPr	Std	UnE	Emp	na	na
Range	10%	12%	7%	13%	9%	5%	na	na

Figure 6.17 Overall bus stop rating by socio-economic status



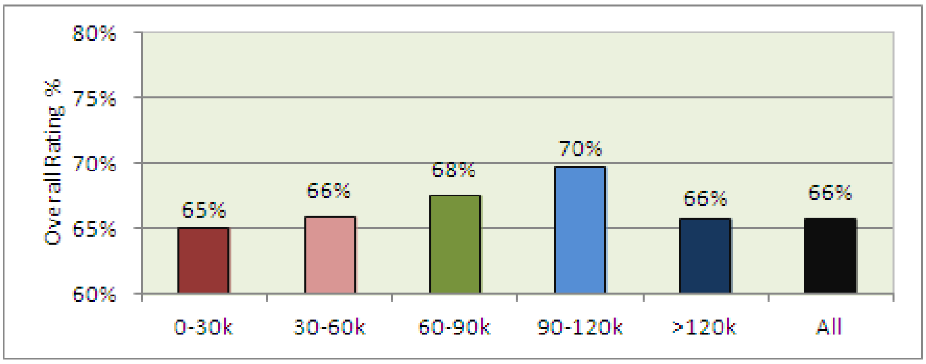
6.11.5 Personal income

The bus stop ratings were compared against personal income (synthetic estimates) and showed a generally positive trend over the first four income categories but then a decrease in the highest category.

Table 6.14 Bus stop ratings by personal income

Income Category	Rating (%)						Sample Size	
	OSAp	Seating	Info	Lighting	Clean/Graf	All	OSAp	All
0-30k	62%	60%	66%	61%	70%	65%	2,010	N
30-60k	61%	60%	69%	65%	72%	66%	806	4,157
60-90k	63%	61%	71%	67%	71%	68%	400	1,716
90-120k	63%	62%	71%	69%	71%	70%	164	781
>120k	61%	55%	67%	63%	69%	66%	129	337
All	62%	60%	68%	63%	71%	66%	3,509	241
High	60-90k	90-120k	60-90k	90-120k	30-60k	90-120k	na	na
Low	30-60k	>120k	0-30k	0-30k	>120k	0-30k	na	na
Range	2%	7%	5%	8%	3%	5%	na	na

Figure 6.18 Overall bus stop rating by personal income ($000 pa)



6.11.6 Respondent age

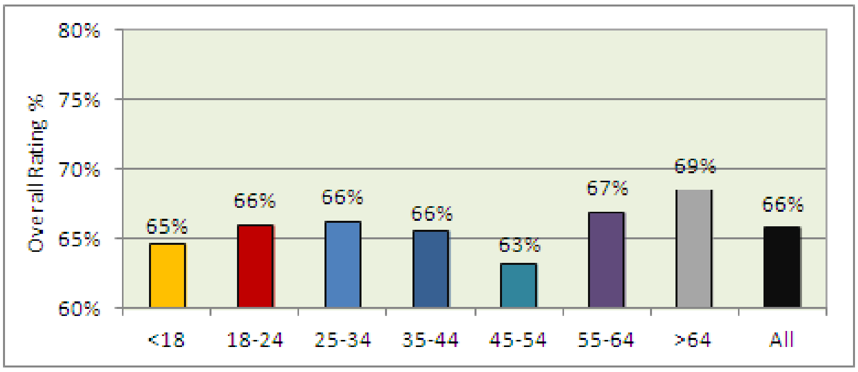
The overall bus stop rating tended to increase with the respondent age (as did the vehicle ratings).

Bus users over 64 had the highest ratings which correlated with the higher retired respondent ratings. Under 18 year olds gave the lowest ratings which also correlated with lower student ratings. The difference was most pronounced for *lighting* with over 64 year olds rating at 70% compared with 51% for under 18 year olds.

Table 6.15 Bus stop ratings by age group

Age Group	Rating (%) Shelter	Seating	Info	Lighting	Clean/Graf	All	Sample Size Shelter	All
<18	60%	54%	61%	51%	68%	65%	462	946
18-24	62%	60%	67%	62%	71%	66%	1,102	2,334
25-34	62%	61%	71%	65%	69%	66%	630	1,385
35-44	62%	60%	71%	67%	70%	66%	367	774
45-54	60%	59%	69%	67%	71%	63%	270	655
55-64	61%	61%	68%	71%	72%	67%	200	407
>64	64%	67%	70%	70%	76%	69%	321	534
All	62%	60%	68%	63%	71%	66%	3,352	7,035
High	>64	>64	25-34	55-64	>64	>64	na	na
Low	<18	<18	<18	<18	<18	45-54	na	na
Range	4%	13%	10%	20%	8%	5%	na	na

Figure 6.19 Bus stop ratings by age group



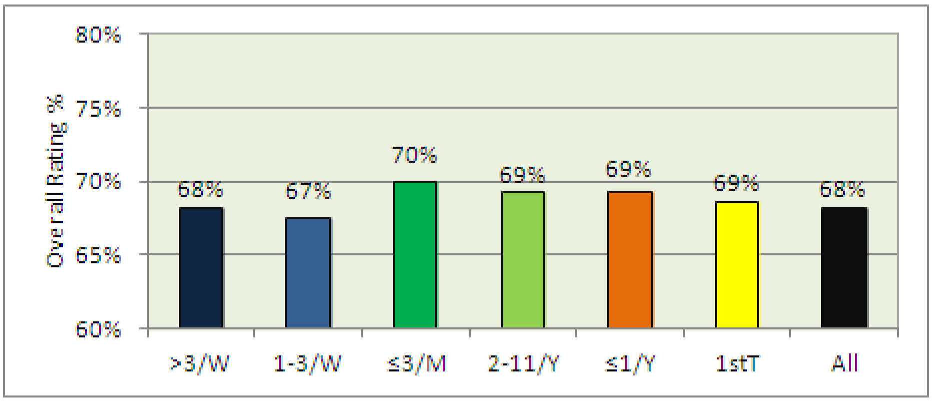
6.11.7 Frequency of use

There was little difference in the overall bus rating according to how frequently respondents used the bus service. The range was greatest for *lighting* with irregular respondents rating at 70% compared with 62% for regular users.

Table 6.16 Bus stop ratings by frequency of use

Frequency	Rating (%)						Sample Size	
of Use	Shelter	Seating	Info	Lighting	Clean/Graf	All	Shelter	All
>3Days/Wk	62%	60%	68%	62%	70%	68%	1,992	1,975
1-3Days/Wk	61%	60%	68%	63%	72%	67%	767	764
1-3Days/Month	63%	63%	69%	67%	74%	70%	228	223
2-11Days/Year	65%	64%	69%	70%	74%	69%	107	108
<=Once/Year	64%	64%	64%	65%	67%	69%	44	44
1stTime	61%	57%	71%	70%	67%	69%	76	76
All	62%	60%	68%	63%	71%	68%	3,214	3,190
High	2-11/Y	2-11/Y	1stT	2-11/Y	≤3/M	≤3/M	na	na
Low	1-3/W	1stT	≤1/Y	>3/W	≤1/Y	-	na	na
Range	4%	7%	7%	8%	7%	3%	na	na

Figure 6.20 Overall bus stop rating by frequency of use



6.11.8 Light and weather conditions

The surveyors noted whether it was light or dark, fine or raining or calm or windy at the time they handed out the questionnaires.

Analysis of response showed there was virtually no difference in ratings between 'dark' and 'light' survey times. Indeed, the *lighting* rating was exactly the same at 63%.

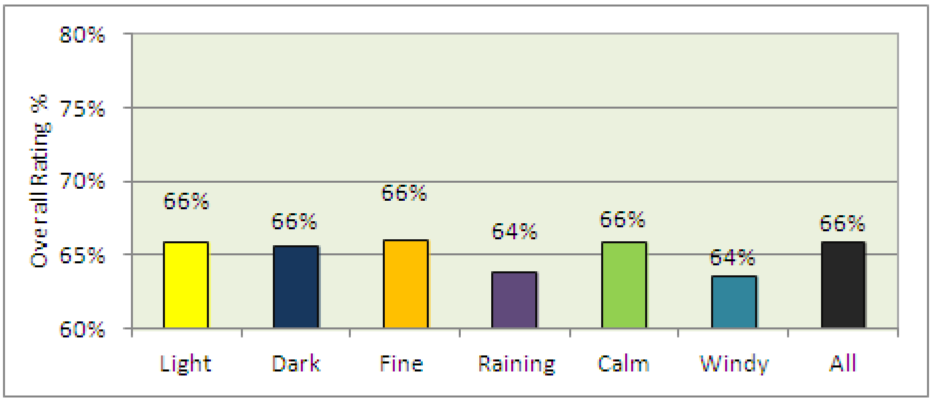
There was a small 2% point reduction in the *overall* rating when it was raining but only 1% point reduction for the *shelter* rating.

More noticeable was a drop of 13% points in the *shelter* rating when it was windy (49%) compared with when it was calm (62%).

Table 6.17 Bus stop ratings with lighting and weather conditions

	Rating (%)						Sample Size	
	Shelter	Seating	Info	Lighting	Clean/Graf	All	Shelter	All
Light	62%	60%	68%	63%	71%	66%	3,372	6,957
Dark	62%	60%	68%	63%	70%	66%	137	275
Fine	62%	60%	68%	63%	71%	66%	3,274	6,706
Raining	61%	59%	71%	65%	73%	64%	235	526
Calm	62%	60%	68%	63%	71%	66%	3,311	6,971
Windy	49%	56%	68%	57%	69%	64%	198	261
All	62%	60%	68%	63%	71%	66%	3,509	7,232

Figure 6.21 Overall bus stop rating with lighting and weather conditions



6.11.9 Type of stop

The greatest range in rating was for the type of bus stop. Bus stations rated the highest at 74% overall. City centre stops were next with 67% and suburban stops were the lowest rated at 63%.

Bus stations rated particularly highly in terms of shelter averaging 94% compared with 80% for city centre stops and 75% for suburban stops. The narrowest range was for seating (58% to 67%).

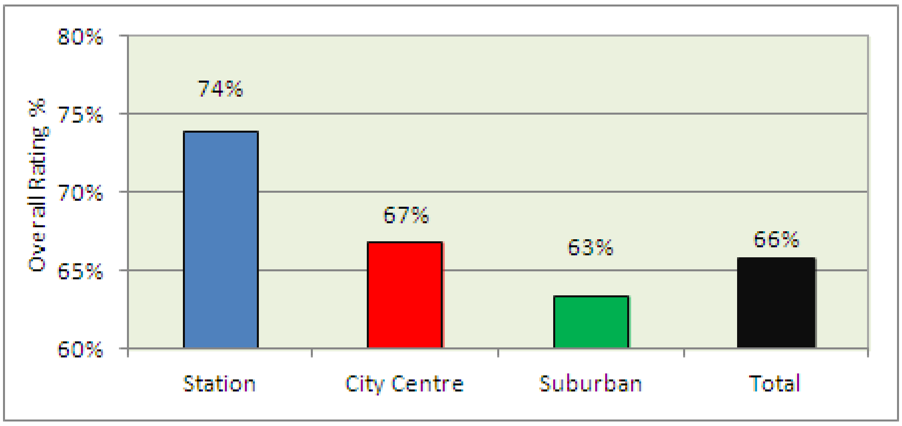
The ratings reflected facility availability which can be seen from the lower portion of table 6.18. Bus stations were more likely to provide shelter, seating, timetables and electronic information compared with city centre stops which were more variable in facility provision. Suburban bus stops usually had the lowest availability. As an example, 94% of respondents surveyed at bus stations indicated that shelter was provided compared with 79% of city centre respondents and 75% of suburban bus stop respondents. The *shelter* ratings nearly matched the profile of shelter availability.

Table 6.18 Bus stop ratings with type of stop

	Rating (%)						Sample Size	
	Shelter	Seating	Info	Lighting	Clean/Graf	All	Shelter	All
Station	94%	67%	76%	74%	79%	74%	466	965
City Centre	80%	61%	71%	69%	72%	67%	974	2,091
Suburban	75%	58%	64%	57%	68%	63%	1,916	3,985
Total	79%	60%	68%	63%	71%	66%	3,356	7,041

Stop Type	Facilities Available				Standard Deviation				N
	Shelter	Seating	Info	RTI	Shelter	Seating	Info	RTI	
Bus Station	94%	92%	92%	80%	24%	27%	27%	40%	468
City Centre	79%	91%	90%	53%	40%	29%	30%	50%	985
Suburban	75%	81%	82%	50%	43%	40%	39%	50%	1,946
All	79%	85%	86%	55%	41%	36%	35%	50%	3,399

Figure 6.22 Overall bus stop ratings with type of stop



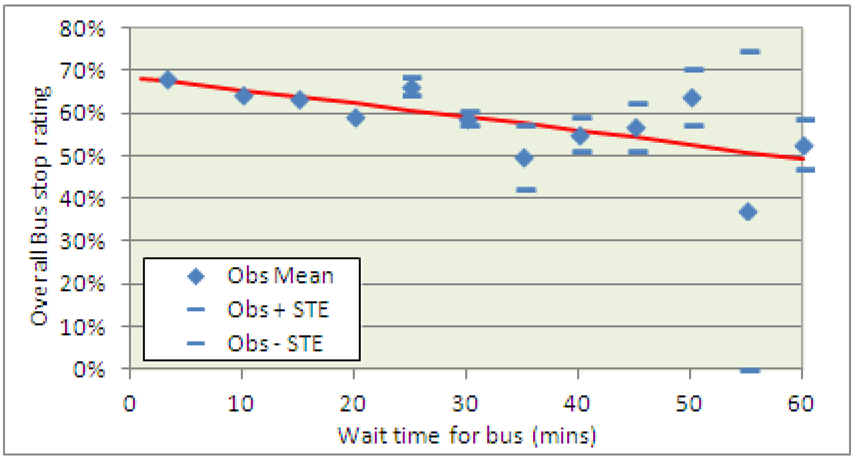
6.11.10 Waiting time at bus stop

The bus stop ratings tended to decrease as waiting time increased. The overall rating declined from 68% for waits of under five minutes to 60% for 20 minutes and 55% for 40 minutes. For longer waits, the range in overall rating was quite wide as can be seen from the error bars in figure 6.22 which reflected the smaller sample sizes.

Table 6.19 Overall bus stop ratings with wait time

	Rating (%)						Sample Size	
Wait Time	Shelter	Seating	Info	Lighting	Clean/Graf	All	Shelter	All
3.3	64%	62%	70%	66%	74%	68%	1,820	3,921
10	59%	59%	66%	61%	70%	65%	798	1,621
15	61%	59%	66%	63%	67%	64%	307	608
20	54%	53%	64%	57%	60%	60%	217	444
25	63%	61%	65%	59%	70%	67%	60	104
30	62%	59%	66%	61%	62%	59%	119	223
35	60%	54%	59%	55%	55%	50%	10	19
40	65%	59%	70%	54%	62%	55%	20	37
45	49%	55%	60%	64%	63%	57%	13	23
50	68%	55%	75%	38%	70%	64%	5	8
55	31%	31%	50%	38%	50%	38%	2	2
60	53%	53%	61%	73%	61%	53%	16	31
Total	62%	60%	68%	63%	71%	66%	3,390	7,048

Figure 6.23 Overall bus stop rating with wait time



6.12 Disaggregate overall rating model

A set of models was estimated on the individual rating response data. Table 6.20 presents the results.

The results follow the aggregate analysis results presented in the previous section. Few statistically significant differences (at the 95% confidence level) were established for the overall rating. None of the time period, journey purpose, gender and frequency of use segmentations was significant. Personal income had a negative relationship with the bus stop rating but was marginally insignificant at the 95% confidence level.

Only two statistically significant passenger profile differences were established. Passengers aged over 64 rated higher than other respondents by around 4% points and retired passengers rated higher than other socio-economic groupings. When the full model was estimated the retired grouping provided a better explanation than the age segmentation.

Rain and wind reduced the overall bus stop rating but darkness had no significant effect.

The biggest differences were by type of bus stop: bus stations rated significantly higher than city centre stops (5% points) which in turn rated higher than suburban bus stops (9%).

Longer waiting times reduced the stop ratings: passengers waiting under six minutes rated 3% points higher than passengers waiting 5 to 10 minutes and passengers who waited more than 10 minutes rated 4% points lower.

A full model was estimated that found the significant effects to be retired passengers, stop type (with city centre and suburban bus stops distinguished from bus stations) and waiting time (longer waits reducing the rating).

Table 6.20 Disaggregate market segment models of overall bus stop rating

Model	Description	Variable	Linear Beta	Linear STE	Linear |t|	Logit Beta	Logit STE	Logit |t|
1	Time Period	OFF PK	-0.011	0.008	1.4	-0.051	0.035	1.4
		PM PK	-0.003	0.010	0.3	-0.012	0.042	0.3
		EVENING	0.010	0.012	0.8	0.045	0.053	0.8
		WEEKEND	0.001	0.008	0.2	0.006	0.036	0.2
		CONSTANT	0.664	0.007	94.9	0.682	0.031	21.8
2	Trip Purpose	EDUC	0.003	0.008	0.4	0.015	0.033	0.5
		PERS BUSN	-0.002	0.009	0.2	-0.007	0.042	0.2
		COMP BUSN	-0.014	0.028	0.5	-0.062	0.128	0.5
		SHOP	0.006	0.010	0.6	0.024	0.045	0.5
		VFR	0.021	0.011	1.9	0.092	0.046	2.0
		ENT/HOL	0.019	0.012	1.6	0.086	0.053	1.6
		CONSTANT	0.654	0.004	148.7	0.638	0.020	32.6
3	Gender	FEMALE	-0.009	0.006	1.6	-0.040	0.025	1.6
		CONSTANT	0.663	0.004	157.9	0.678	0.019	36.3
4	Age Group	UNDER 18	-0.010	0.009	1.1	-0.042	0.038	1.1
		AGE 18-24	0.003	0.006	0.5	0.013	0.028	0.5
		OVER 64	0.029	0.011	2.6	0.130	0.056	2.3
		CONSTANT	0.656	0.004	160.1	0.647	0.018	36.0
5	Socio-Economic Status	STUDENT	0.009	0.006	1.4	0.038	0.027	1.4
		HSEPERS	0.024	0.016	1.5	0.108	0.078	1.4
		RETIRED	0.046	0.012	4.0	0.211	0.059	3.6
		UNEMPLOYED	0.006	0.016	0.4	0.026	0.071	0.4
		CONSTANT	0.651	0.004	167.0	0.624	0.018	35.7
6	Personal Income	PY	-0.0002	0.0001	1.9	-0.0008	0.0004	1.9
		CONSTANT	0.664	0.004	153.8	0.683	0.019	36.0
7	Frequency of Use	OCCASIONAL	0.035	0.023	1.5	0.159	0.101	1.6
		RARE	0.031	0.022	1.4	0.142	0.091	1.6
		CONSTANT	0.657	0.003	230.6	0.651	0.013	50.1
8	Light & Weather	DARK	-0.005	0.015	0.4	-0.024	0.066	0.4
		RAINING	-0.021	0.011	1.9	-0.092	0.048	1.9
		WINDY	-0.024	0.015	1.6	-0.103	0.064	1.6
		CONSTANT	0.661	0.003	220.3	0.667	0.013	51.3
9	Stop Location	CITY CENTRE	-0.059	0.009	6.8	-0.279	0.039	7.2
		SUBURBAN	-0.094	0.008	11.9	-0.436	0.036	12.1
		CONSTANT	0.727	0.007	104.6	0.980	0.032	30.6
10	Wait Time	WAIT≤5	0.037	0.007	5.5	0.165	0.030	5.5
		WAIT>10	-0.032	0.008	4.0	-0.139	0.035	4.0
		CONSTANT	0.646	0.006	117.5	0.603	0.024	25.1
11	Wait Time (mins)	WAIT TIME	-0.003	0.000	10.6	-0.015	0.002	10.0
		CONSTANT	0.688	0.004	176.4	0.784	0.018	43.6
12	Full Model	VFR	0.020	0.010	2.0	0.089	0.043	2.1
		RETIRED	0.043	0.011	3.9	0.198	0.058	3.4
		RAINING	-0.035	0.011	3.3	-0.156	0.047	3.3
		CITY CENTRE	-0.058	0.009	6.8	-0.280	0.039	7.3
		SUBURBAN	-0.094	0.008	12.0	-0.436	0.036	12.0
		WAIT TIME	-0.003	0.000	10.5	-0.015	0.002	9.6
		CONSTANT	0.754	0.005	139.3	1.100	0.035	31.5

Models fitted on 7,232 observations

6.13 'Grand final' overall bus stop rating explanation model

The model was extended to take account of facility provision. The variables reduced the parameter size of the bus stop type variables by taking account of the greater tendency for facilities to be available at bus stations than at city centre and suburban bus stops.

The introduction of facility availability variables also increased the difference between retired respondents and non-retired respondents. However, the difference between respondents 'visiting friends and relatives' and other respondents lessened and became statistically insignificant.

Table 6.21 Grand final bus stop rating explanation model

Model	Description	Variable	Linear			Logit		
			Beta	STE	|t|	Beta	STE	|t|
12	Grand final model	Shelter	0.137	0.011	12.5	0.599	0.046	13.1
		Seating	0.045	0.013	3.5	0.189	0.058	3.3
		Timetable	0.033	0.012	2.8	0.148	0.057	2.6
		RTI	0.054	0.008	6.5	0.261	0.035	7.5
		Retired pax	0.055	0.011	5.1	0.229	0.056	4.1
		Raining	-0.034	0.010	3.3	-0.148	0.046	3.2
		City centre	-0.047	0.008	5.6	-0.230	0.038	6.1
		Suburban	-0.076	0.008	9.9	-0.358	0.035	10.2
		Wait time	-0.003	0.0003	10.6	-0.015	0.002	9.5
		Constant	0.536	0.015	37.0	0.264	0.073	3.6

Models fitted on 7,232 observations (mean values input for shelter, seating, timetable and RTI)

Base group is a bus station, fine weather, non-retired passenger, zero wait time.

6.14 Relative importance of bus stop attributes

The relative importance of bus stop attributes was assessed in terms of the ability to explain the overall rating. The approach was the same as that used for vehicle ratings except that the rail ratings were omitted due to the longer list of attributes.

The sample was limited to the rating survey which provided 3,479 observations. As with the vehicle ratings, 'non-rating' responses were retained but treated as a zero rating.

Table 6.22 presents the fitted models. As well as the average rating, it shows the percentage of respondents giving a rating and the adjusted rating (ie where non-ratings were treated as a zero rating). The adjustment was only noticeable for *lighting* (where 219 respondents did not provide a rating which produced an adjustment factor of 94%).

The linear model explained around two-thirds of the variation in the overall rating. The most important attribute was *cleanliness and graffiti* (which explained 22% of the overall rating). Slightly less important were *weather protection* and *seating* (20% each). *Information* was less powerful (16%) and *lighting* least important (8%).

Table 6.22 Bus stop rating explanatory basic model

Variable	Rate %	Rating %	Adjusted Rate %	Linear β	Linear STE	Linear |t|	Logit β	Logit STE	Logit |t|
Weather Protection	99%	61.7%	61.2%	0.199	0.010	19.9	0.999	0.064	15.6
Seating	99%	60.1%	59.6%	0.193	0.011	17.9	0.997	0.070	14.3
Information on bus times	98%	67.8%	66.7%	0.155	0.010	15.5	0.797	0.068	11.7
Lighting	94%	63.1%	59.1%	0.082	0.009	9.4	0.448	0.056	8.0
Cleanliness & Graffiti	98%	70.7%	69.4%	0.221	0.009	24.9	1.097	0.058	18.9
Constant (α)	na	na	na	0.139	0.008	18.3	-1.884	0.052	36.2
Overall Rating		58%		na	na	na	na	na	na
R Squared					0.638			na	
Observations					3,479			3,479	

* Overall ratings tabulated

6.15 Bus stop attribute importance and comparison with Gravitas Auckland survey

Table 6.23 summarises the relative importance of the individual attributes in explaining the overall bus stop rating and compares the result with a similar analysis undertaken on the Gravitas Auckland data. Importance was calculated by dividing each parameter by the sum of the parameters excluding the constant.

Table 6.23 Relative importance of stop attributes in explaining overall bus stop rating

Variable	Pricing Strategies Linear	Pricing Strategies Logit	Gravitas Auckland
Weather Protection	23%	23%	15%
Seating	23%	23%	9%
Information on bus times	18%	18%	7%
Lighting	10%	10%	na
Cleanliness & Graffiti	26%	26%	29%
Ease of getting on bus from stop	na	na	8%
Easy to get to (by car,walking)	na	na	15%
Personal Safety at Stop	na	na	17%
Total	100%	100%	100%

na not asked

The linear and logit models gave exactly the same percentage importance. *Cleanliness and graffiti* was the most important attribute (26% of the overall rating) with *weather protection* and *seating* second equal (23% each). *Information* was slightly less important (18%) with *lighting* least important (10%).

As with the vehicle ratings, a 'like for like' comparison with the Gravitas survey was not possible because the list of attributes and their description differed. However, analysis did show that *cleanliness and graffiti* (combined) was also the most important explanatory Gravitas factor with *weather protection* second. *Seating* was less important. The Gravitas survey included three additional factors: *personal safety* (17%) and *ease of getting to the stop* (15%) and *ease of getting on the bus* (8%).

6.16 Bus stop attribute importance by market segment

The basic model was extended to allow for gender, journey purpose, age, frequency of use and socio-economic status. Wait time was also included by distinguishing a short wait of one to five minutes and long waits of over 10 minutes from medium waits of 6 to 10 minutes. Finally, whether it was dark or light, raining or fine, windy or calm, or a weekday or weekend when the survey took place, was taken into consideration.

Five 'effects' were significant at the 95% confidence level as shown in table 6.24. Retired passengers attached a greater importance to weather protection and young passengers to information. Long waits (>10 minutes) increased the importance of information but surprisingly decreased the importance of seating and weather protection although in the logit model, the weather protection and seating effects were not significant at the 95% confidence level.

Table 6.24 Bus stop rating explanatory full model

Variable	Linear			Logit		
	β	STE	|t|	β	STE	|t|
Weather protection (WP)	0.205	0.011	18.3	1.026	0.070	14.7
Seating (SEAT)	0.204	0.012	16.9	1.05	0.076	13.8
Information (INFO)	0.134	0.011	12.2	0.691	0.073	9.5
Lighting (LGHT)	0.088	0.009	10.1	0.483	0.055	8.8
Cleanliness and graffiti (CG)	0.217	0.009	24.7	1.077	0.058	18.6
Retired * WP	0.040	0.012	3.4	0.376	0.098	3.9
Young * INFO	0.045	0.010	4.5	0.265	0.057	4.7
Wait >10mins * WP	-0.047	0.022	2.1	-0.258	0.136	1.9
Wait >10mins * SEAT	-0.053	0.025	2.1	-0.276	0.166	1.7
Wait >10mins * INFO	0.063	0.019	3.3	0.288	0.126	2.3
Constant (α)	0.140	0.008	18.4	-1.876	0.052	36.1
R squared	0.644			na		
Observations	3,479			3,479		

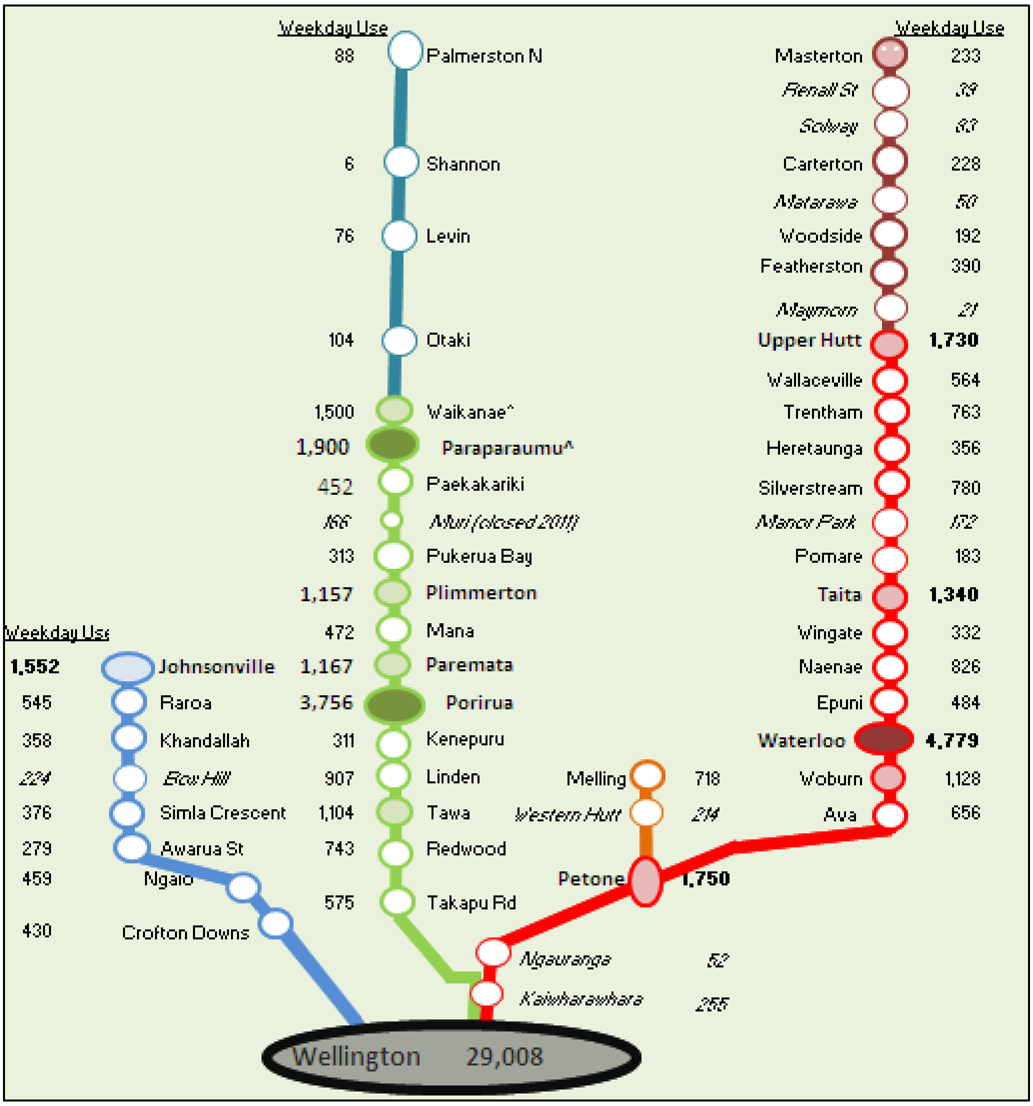
Note * denotes multiplicative interaction

6.17 Wellington train stations covered by the survey

At the time of the survey there were 49 stations in the Tranz Metro network.[47] A schematic map of the Wellington network is presented in figure 6.24. An estimate of the number of passenger boardings and alightings per weekday is given alongside each station.

[47] Muri station was closed in May 2011 and Kaiwharawhara station in December 2013 by the GWRC. There are also four stations on the Capital Connection. Otaki, which is within the GWRC, Levin, Shannon and Palmerston North. These stations were surveyed in 2004 using a similar rating survey and the data is included in the explanation analysis.

Figure 6.24 Wellington train station network



Figures are av. weekday use (train ons + train offs) in 2004 estimated by Douglas Economics. Source: NJD/ file=
Source: NJD/ file= NZSPSS_Rating_3.xls

The stations were classified into three types. Four stations were classified as hubs (H): Wellington, Porirua, Paraparaumu and Waterloo. Johnsonville and Upper Hutt have lower usage and were defined as 'major' stations (M) alongside Waikanae, Plimmerton, Paremata, Tawa (all on the Kapiti line) and Taita and Woburn on the Hutt Valley line. Masterton was also defined as a major station despite lower usage. All other stations were defined as 'local' (L).

Table 6.25 presents a summary of the stations indicating which facilities are available.

Table 6.25 Wellington train stations and facilities

Station	Code	Class	Up-grade+	Plat access	Staff	Toilet	Retail/ cafe	Ticket office	Car park	Bus trfr	Notes
Wellington	WEL	H		F&O	Y	Y	Y	Y	Y	Y	Small car park
Kaiwharawhara	KAI	L		O							No shelter/closed Dec 13
Ngauranga	NGG	L		S							Island platform
Petone	PET	M	2004	F&O&S	Y	Y	Y	Y	Y	Y	Further upgrade in 2010
Western Hutt	WES	L		1P			Y				Pub/café adjoining
Melling	MEL	L		1P			Y		Y	Y	Bus stop is provided
Ava	AVA	L		O							Street car parking
Woburn	WOB	M		O					Y		
Waterloo	WAT	H		F&S	Y	Y	Y	Y	Y	Y	
Epuni	EPU	L	2008	S							
Naenae	NAE	L	2012	S							
Wingate	WIN	L		O							
Taita	TAI	M		S						Y	Island plat/bus stop adj
Pomare	POM	L		S							Island platform
Manor Park	MAP	L		F					Y		Island platform
Silverstream	SIL	L		F					Y	Y	Island platform
Heretaunga	HER	L		F&O							Island platform
Trentham	TRE	L		F&O					Y	Y	Island platform
Wallaceville	WAL	L		1P					Y		Island platform
Upper Hutt	UPP	M		F	Y	Y		Y	Y	Y	Island platform
Maymorn	MAY	L		1P					Y		
Featherston	FEA	L		1P	Y	Y		Y	Y	Y	
Woodside	WOO	L		1P		Y			Y	Y	
Matarawa	MAT	L	2007	1P					Y		No platform before 2007
Carterton	CAR	L		1P	Y	Y	Y	Y	Y		Privately run ticket/shop
Solway	SOL	L	2007	1P					Y		Building renovated 2013
Renall St	REN	L	2007	1P							
Masterton	MAS	M		1P	Y	Y	Y	Y	Y		Renovated in 2007
Takapu Rd	TAK	L		F&O					Y		
Redwood	RED	L		F					Y		
Tawa	TAW	M		O					Y		
Linden	LIN	L		F&O					Y		
Kenepuru	KEN	L		F&O							
Porirua	POR	H		S	Y	Y	Y	Y	Y	Y	
Paremata	PAM	M		O&S					Y	Y	
Mana	MAA	L		F&S					Y		
Plimmerton	PLI	M	2010.8	F&S			Y		Y		

Station	Code	Class	Up-grade+	Plat access	Staff	Toilet	Retail/ cafe	Ticket office	Car park	Bus trfr	Notes
Pukerua Bay	PUK	L		F					Y		Island platform
Paekakariki	PAE	L		F			Y		Y		Museum on platform
Paraparaumu	PAP	H	2011.5	F&S	Y	Y	Y	Y	Y	Y	
Waikanae	WAI	M	2011	F	Y	Y	Y		Y	Y	
Crofton Downs	CRO	L		1P					Y		
Ngaio	NGO	L		F					Y		
Awarua St	AWA	L		1P							
Simla Crescent	SIM	L		1P					Y		
Box Hill	BOX	L		F&S							Adjacent bus stop
Khandallah	KHA	L		1P					Y		
Raroa	RAR	L		1P							Ramp overbridge to school
Johnsonville	JOH	M		1P	Y		Y	Y	Y	Y	

Class: H: hub; M major; L local (classification by Douglas Economics based on facilities and patronage)

Platform access codes: 1P denotes one platform with flat access. F denotes flat access to platforms not via subway or overbridge; O platforms accessed by overbridge; S denotes subway. + significant upgrade as judged by Douglas Economics, excludes renovation or improvements to one or two attributes. Original table revised with help of Mike Mellor 28 September 2016.

Next to the station classification, the year of the last major upgrade (if post-2004) is given. Only upgrades considered major have been dated. Other stations have been renovated such as Carterton and Woodside but the work was considered less substantial than a major upgrade. A fuller listing of works undertaken at train stations in the Wellington since 2004 is provided in the 'Before and after' analysis in section 6.23.

Table 6.25 also classifies platform access. Wellington train station has 'flat' access from the street that does not require the use of an overbridge or a subway, although the link to the bus terminal is via a subway (and the link to the stadium via a ramp/staircase). As the Johnsonville and Wairarapa lines are single track, the stations do not require an overbridge or subway (although Raroa does have a 'short-cut' ramp to the nearby school). Several stations have an overbridge such as Kaiwharawhara.[48] Other stations, such as Ngauranga and Naenae, have a subway. Some stations such as Linden have flat access at one end of the platform often involving a level crossing and an overbridge at the other end, or like Plimmerton, flat access and a subway.

Table 6.25 also indicates which stations have staff, a toilet, a cafe and/or retail shops, ticket office, off-street car parking and bus transfer.

The following section present photographs and a short description of most Wellington stations. The stations are presented by line.

[48] The Kaiwharawhara overbridge was considered to have corroded to such an extent because of a lack of preventative maintenance that the GWRC permanently closed the station in December 2013.

6.18 Train stations on the Wellington network

Sections 6.18.1 to 6.18.4 present photographs of the train stations on the Wellington network as a basis for understanding the passenger ratings. Most of the photographs were taken by Neil Douglas in December 2013, a year after the surveys were undertaken.

6.18.1 Johnsonville line stations

Crofton Downs has a commuter car park, which was full like most of the car parks photographed. NJD

Like all the Johnsonville line stations, Awarua St has had its platform raised and resurfaced to accommodate the new Matangi trains. Electronic train indicator boards. (NJD)

Ngaio has train indicator boards placed high up on poles (to avoid vandalism), like most stations in the Wellington region. (NJD)

Simla Crescent has a commuter car park over the level crossing and a bus stop. Box Hill does not have a car park and has low usage. The station is down a ramp from the main road. (NJD)

On the left, Khandallah has a car park and is accessed by a level crossing. In the centre, Raroa serves the nearby school and has a pedestrian ramp. There is a bicycle rack on the platform. (NJD)

Johnsonville is the terminal station at the end of the 11km rail line. It is the busiest station and was being repainted when it was photographed in December 2014. There is car parking and the Johnsonville hub for Mana Coaches. (NJD)

6.18.2 Kapiti line stations

The photographs except for Tawa and Mana (Steve Bird GWRC) and Redwood and Pukerua Bay (Wikipedia) were taken by Neil Douglas in December 2013 a year after the questionnaire survey was undertaken.

Redwood station has a car park on the right. The platforms were demolished and replaced in 2010. (WP)

Takapu Road has stair access from the main road and a ramp access from a minor road. (NJD)

At the time of the survey Tawa was as photographed by Steve Bird of GWRC on the left. The shelter was replaced with a new shelter on the right in 2013. (SB)

Linden is accessed via a longish walkway over a level crossing from one end and via an overbridge at the other. (NJD)

Kenepuru serves the nearby hospital and has a narrow walkway with no lighting. There is no car parking. The station has low use and the waiting shelter has been spray painted and the glass etched with broken CDs. The station was the worst visited. (NJD)

Porirua is a hub station with a large car park and bus transfer. The station has bicycle racks but some passengers still prefer to lock their bicycles to lamp-posts on the platform. Access to the station platforms is by an underpass that is well lit. (NJD)

Paremata has a large car park with underpass access at one end and overbridge at the other; the platform surface is uneven and has a platform bicycle rack. (NJD)

Mana station at the time of the survey had shelters with leaking roofs. The roofs have since been repaired and the subway repainted. (SB)

Plimmerton has a car park opposite. There is subway access (it was being cleaned when photographed) and a level crossing access. There is a privately run model railway shop and cafe operating in the station building. The platform has a bicycle rack and bicycle lockers (not shown) (NJD).

Pukerua Bay station (WP) on the left has an island platform (rebuilt 2010) reached via a grade crossing at the southern end. There is a car park on the west side. Paekakariki is an old station with a museum (on right). There is a large car park and access is via a level crossing at the end of the platform. (NJD)

Paraparaumu has a full range of facilities including a well-kept toilet, waiting room and ticket office. Access is via a subway to the nearby mall which has a large car park. (NJD)

Waikanae has a new station after electrification extension, with modern waiting shelters, a waiting room, a smooth platform surface with-non slip tiling, a car park and bicycle racks. (NJD)

6.18.3 Hutt Valley line stations

Ngauranga station has very low use. Access is via a tunnel from the old Hutt road which has a bus stop but there is no signing of the train station. (NJD)

The main station building at Petone station was rebuilt in 2003. It has a long ramp overbridge to the car park which is well used. The platform shelters were not rebuilt but the platform has been resurfaced. (ND)

Western Hutt is on the Melling line and is difficult to find from the road. There is no car parking for the station. Access is via a passageway next to the Parrot & Jigger pub. You can walk into the pub from the platform. (NJD)

Melling is the terminus of the Melling line and has a large car park, bicycle rack and locker, telephone kiosk, and bus stop. The station building (including a café) was closed in Dec 2013 by GWRC because of asbestos. (NJD)


Ava station suffers from graffiti and the station is repainted every two weeks. Ava has a ramp and stairs access. (NJD)


Woburn station has a large car park which was full when photographed. The station is accessed by a ramp overbridge. (NJD)


Waterloo station is a major interchange and has a large car park and bus stops (see bus stop photo). (NJD)

Wingate has a similar platform shelter to Heretaunga. This photograph was taken by Steve Bird (GWRC) in 2012 before the survey was undertaken and the shelter has since been repainted.


Naenae station has been refurbished. The subway has been repainted and strip lighting introduced but the walkway is still uneven. A new seating and shelter area has been built and the platform has been resurfaced. (NJD)

Heretaunga station – see comments above for Wingate station.



Taita station (on the left) is where some trains start/finish and has an island platform with subway access to the street. The centre and right photographs are of Pomare which also has an island platform accessed by a subway. Pomare station has been repainted and has a bike rack on the approach to the subway entrance. (NJD)



Silverstream station (left and centre) is accessed by a level crossing where there is a nearby school and shops. The flower commemorates a fatal accident on the crossing in 2003. Gates were subsequently introduced. Two bicycles are locked to the bicycle rack. Wallaceville station (on the right) is also accessed by a level crossing and is on single track line thereby facilitating platform access. (NJD)


Upper Hutt station is the terminus for Hutt Valley line services and is a transfer station to the Wairarapa line. The station has not been upgraded and the platform surface is worn. The station has a taxi rank and car par, and bus stops outside. (NJD)

6.18.4 Wairarapa line stations

All the stations were photographed in Dec 2013 excepting Maymorn which was photographed in May 2013.


Maymorn (left-hand photo) is on the Upper Hutt side of the Rimutaka hill range and has had a new 'bus stop' style shelter installed..

Featherston station on the other side of the hill is a rail head for Wairarapa commuters who either drive or use the bus service from Martinborough/Masterton. There is only one platform because the station, as with all Wairarapa stations, is on a single track. (NJD)


Carterton station is well used and has a privately run ticket office/shop. The station has a car park. (NJD)

Solway (on the left) and Renall Street serve Masterton. Both have been upgraded with new shelters, resurfaced platforms and new ramps installed. Solway has a car park, Renall Street does not. (NJD)

Matarawa station is between Greytown and Carterton and has a very sparse catchment. The platform has been upgraded with a new ramp and lighting.

Masterton station is the terminal station for the Wairarapa line. The station was upgraded in 2007. There is a large car park and the station has a ticket office, waiting room and toilet all of which are very clean and tidy. (NJD)

6.18.5 Wellington train station

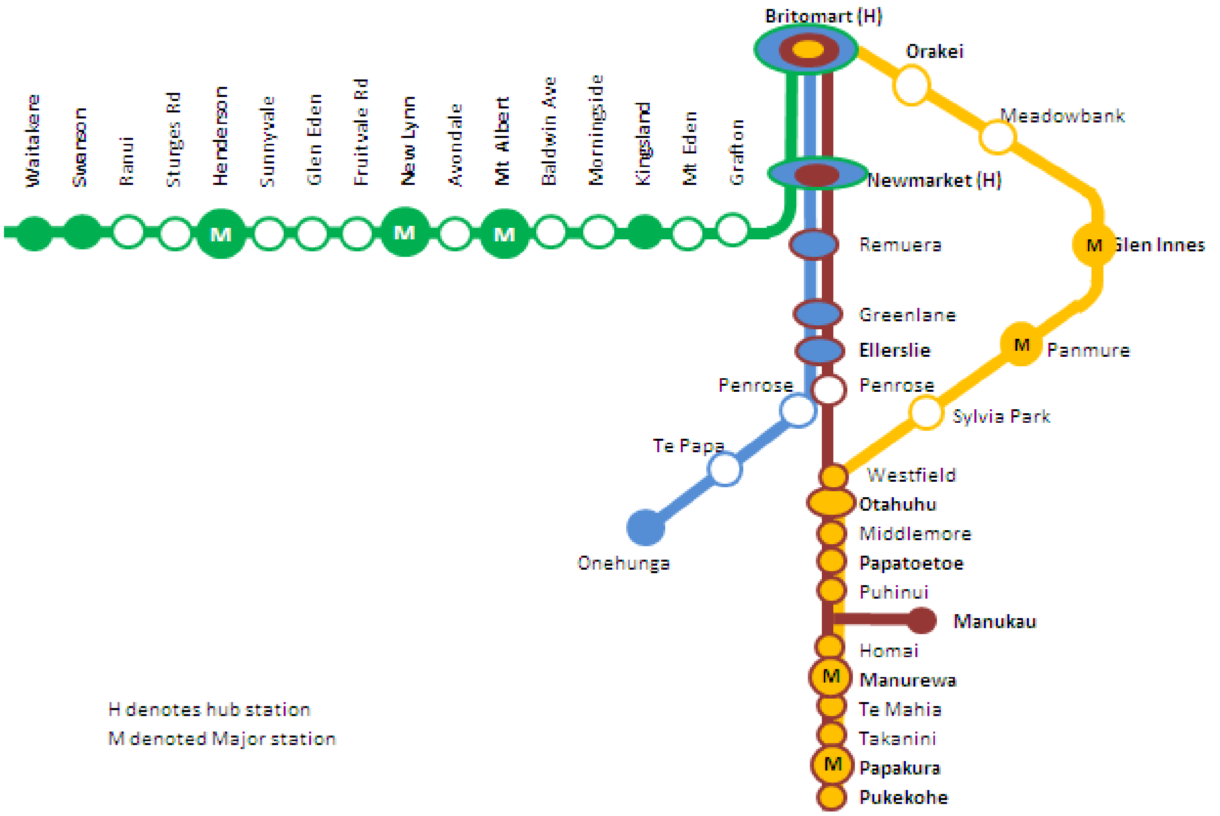
Wellington train station was photographed in December 2013 by Fei Xu.

Wellington train station was completed in 1936 and is New Zealand's busiest passenger station with 29,000 passengers getting on and off trains per weekday (Douglas Economics estimates 2004/5). The concourse floor has been resurfaced. There is a subway to the bus station. (FX)

6.19 Auckland train station facilities

The Auckland rail network has 42 stations on four timetabled corridors as shown schematically in figure 6.25.[49]

Figure 6.25 Auckland train station network



AT classifies stations into hub, major, intermediate or local depending on patronage and how the station relates to the overall passenger transport network. Over the last decade, most of the stations have been upgraded and a new station has been built at Britomart in central Auckland.

Britomart, an underground station built in 2003 and classified by AT as one of two 'hub' stations. (FX)

Newmarket station, upgraded in 2010 with four platforms and escalator/lift platform egress via an overhead walkway is the second 'hub' station on the Auckland rail network (WP)

[49] Penrose station is counted as two stations

Britomart and Newmarket are classified as 'hub' stations. Glen Innes, Henderson, Manurewa, Mt Albert, New Lynn, Panmure, Papakura are defined as 'major' stations with high use. There are 11 'intermediate' stations of which Glen Eden is an example and 20 local (L) stations usually with less than 1,000 'ons' and 'offs' per day.

Auckland train stations have been upgraded and modified as part of double tracking the western line and as preparation for electric train operations (mid-2014).

All stations provide for mobility access and several stations have lifts where available space limits the construction of ramps to overbridges, as at Papakura, Middlemore, Sylvia Park, Britomart, Newmarket, Ellerslie, Kingsland, Mt Albert, New Lynn, Henderson and Swanson.

All stations have ticket vending machines and card readers (no tickets are sold on board trains). Britomart and Newmarket have ticket gates.

Six stations had not been upgraded over the previous decade (2003–2013) when the survey was undertaken. These stations included Mt Albert, Takanini and Pukekohe (see photo).

Pukekohe station which has not been refurbished and features ramp access (WP)

Westfield station has a walkway to an overbridge. The station had not been upgraded at the time of the survey as the station's future has been under review. (WP)

The platforms at Papakura were lengthened in 2007 and the station rebuilt in 2012/13 on the western side of platform with a refurbished ticket office.

Waitakere was scheduled for closure and Westfield and Te Mahia were under review. Westfield station was considered representative of suburban stations prior to upgrade and similar to Waitakere and Te Mahia except the latter has better lighting and CCTV.

Table 6.26 classifies the stations and gives the dates the station was built or upgraded.

Most of the stations on the Western line were upgraded when the line was double tracked between 2005 and 2010. Some other upgrades were undertaken as part of bigger schemes included in transport strategies and plans, community projects or adjacent developments. Sylvia Park station was built in 2008 by the developers of the shopping centre and has become one of the busiest stations on the network.

Mt Albert[50] and Panmure[51] were surveyed prior to upgrading when the survey was undertaken in February to-May 2013. Manukau station was not fully completed.

In terms of ease of getting to or from the platforms, stations differ according to whether access to the platform is via a pedestrian only overbridge (PO) or subway (S) or whether there is a road overbridge. Several stations are either single side platforms or there is pedestrian access with signalised pedestrian

[50] Mt Albert is to be redeveloped in two stages.

[51] Panmure is being redeveloped as part of the AMETI project.

mazes where crossing a track is required. It should be noted that AT's policy is to avoid subways where possible due to perceived security risks.

For Britomart, Newmarket, New Lynn and in the future Panmure, main access is through a station building above the rail tracks with access to the platforms by escalators/lifts. Lifts are provided at some other stations where a mobility compliant access ramp cannot be built due to space constraints.

Toilets are only provided at terminal stations or at major interchanges. AT policy is that toilets should not be provided elsewhere due to plumbing/cleaning requirements and perceived security risks; however, they should be provided nearby as a community facility (not specifically for rail customers).

All stations are equipped with ticket and HOP card top-up vending machines (cash and Eftpos).

Five stations are staffed with ticket selling and customer help facilities: Britomart, Newmarket, New Lynn, Papakura and Pukekohe.[52]

Food and drink outlets/vending machines are provided at three stations: Britomart, Glen Eden and Swanson. Outlets are 'not encouraged' as it is a policy not to consume food or drink on trains. Many stations are adjacent to shopping centres and coffee carts may temporarily locate themselves in adjacent car parks during the morning peak; however, the only facilities at the station are within the Britomart complex, as well as cafes operated by private individuals such as Glen Eden and Swanson in the historic station buildings.

Table 6.26 Auckland train stations

Station	Code	Class	Line+	Upgrade	Access	Lift/ esc	Staff	Toilet	Retail	Car park	Bus trfr	Notes
Avondale	AVO	I	W	2011	F							
Baldwin Ave	BAL	L	W	2011	F							
Britomart	BRI	H	ESWO	2004	U	L&E	Y	Y	Y		Y	
Ellerslie	ELL	I	SO	2009	O&S							
Fruitvale Rd	FRU	L	W	2007	F							
Glen Eden	GLE	I	W	2007	F&O					Y		
Glen Innes	GLI	M	S	2004	F&S					Y	Y	
Grafton	GRA	I	W	2010	O	L					Y	
Greenlane	GRE	L	SO	2013	O							
Henderson	HEN	M	W	2007	O	L&E		^			Y	
Homai	HOM	I	ES	2006	F					Y	Y	
Kingsland	KIN	L	W	2011	F&O&S							8
Manukau	MAK	M	S	2012	O		^	Y			Y	1
Manurewa	MAR	M	ES	2007	F&O					Y	Y	
Meadowbank	MEA	L	S	2005	O					Y		
Middlemore	MID	M	ES	2009	F&O	L		^				
Morningside	MOR	L	W	2010	F&S							
Mt Albert	MTA	M	W	No	O&S	L		^			Y	7

[52] As more ticket gates are installed across the network, there will be a requirement to have a staff presence at other stations.

Station	Code	Class	Line+	Upgrade	Access	Lift/ esc	Staff	Toilet	Retail	Car park	Bus trfr	Notes
Mt Eden	MTE	L	W	2008	F&O							
Newmarket	NEW	H	SWO	2010	O	L&E	Y	Y			Y	
New Lynn	NWL	M	W	2011	O	L&E	Y	Y			Y	
Otahuhu	OHU	L	ES	2013	O							
Onehunga	ONE	I	O	2011	1P			^		Y	Y	
Orakei	ORA	L	S	2004	O					Y		
Panmure	PNM	M	S	2008	O					Y		2
Papakura	PAK	M	ES	2008	F&O	L	Y	Y		Y	Y	
Papatoetoe	POE	I	ES	2005	F&O					Y	Y	
Penrose	PEN	L	SO	2013	O							
Pukekohe	PKK	I	ES	No	O		Y	Y		Y		
Puhinui	PUH	L	ES	2006	O							
Ranui	RAN	I	W	2005	F					Y		
Remuera	REM	L	SO	2013	O							
Sturges Rd	STU	L	W	2008	F					Y		
Sunnyvale	SUN	L	W	2007	F							
Swanson	SWA	L	W	2008	F&O			Y	Y	Y	Y	3
Sylvia Park	SYL	I	S	2008	O						Y	4
Takanini	TAN	I	ES	No	F							7
Te Mahia	TEM	L	ES	No	F							5
Te Papapa	TEP	L	O	2011	1P							
Waitakere	WAK	L	W	No	1P					Y		6
Westfield	WFL	L	ES	No	O			Y				5

Class: H: Hub; M major; I: Intermediate; L Local (in analysis local and intermediate were combined)

Notes: 1P - single platform station; U underground; O overbridge; S subway

1: Surveyed before new station was fully completed as a terminal interchange.

2: Surveyed prior to redevelopment as a rail/bus interchange with ticket office and toilets (2014 completion).

3: Privately operated café. 4. Adjacent to shopping centre. 5. Station under review. 6. Station to be closed.

7. Station redevelopment completed in mid 2013 after passenger survey completed.

8. Upgraded in stages: 2004 new station, 2006 platforms lengthened, 2011 new shelter.

+Line codes: E East, S South, W West, O Onehunga. Original table revised with help of Mike Mellor 28 September 2016.

Park and ride facilities are available at stations marked as ‘Y’. There is informal street parking at all locations, although in town centres such as Henderson and New Lynn this may be metered/time limited. Drop-off (‘kiss and ride’) bays are also provided at most stations.

Bus transfer is available at ‘Y’ demarked stations. There are also stations where there is an adjacent bus stop. The number of bus/rail transfer stations is expected to increase.

Kingsland station has been upgraded in stages from 2004 when it was rebuilt for western line double-tracking, 2006 platform lengthening and 2011 when shelters were built for the rugby world cup. (WP)

New overbridge with lifts being constructed at Swanson station. (AKTNZ)

6.20 Station ratings

Tables 6.27 and 6.28 and figure 6.26 present the range in passenger ratings by station for the Wellington and Auckland systems. Figure 6.27 presents the overall rating for each station and appendix F (see part 3 of this report) presents a full tabulation of the attribute ratings. As with the bus stop ratings, only respondents who gave a rating have been included.

Table 6.27 Range in rating of Wellington train stations

	Attribute Rating														Sample*	
Station	WP	Seat	Plat	OnOf	Info	Lght	C&G	Toil	Stff	Ret	Tick	Car	Bus	All	WP	All
Maximum	73%	75%	88%	89%	75%	74%	83%	62%	75%	75%	75%	81%	80%	76%	399	976
Station	WAT	NAE	SOL	REN	PET	PET	WAI	WEL	WAI	WEL	WAI	WOO	NAE	WAI	WEL	WEL
Av (Station)	53%	47%	62%	70%	52%	56%	57%	22%	35%	24%	35%	57%	50%	55%	48	48
Av (Resp)	58%	50%	64%	73%	59%	61%	61%	37%	53%	47%	55%	62%	63%	64%	2,231	3,274
Minimum	31%	3%	28%	42%	9%	22%	16%	0%	0%	0%	0%	6%	13%	25%	3	3
Station	KAI	KAI	AVA	NGG	KAI	AVA	AVA	KAI	KAI	KAI	KAI	NGG	PUK	AVA	NGG	NGG

Manor Park, Manor Park and Maymorn not included as either zero or only 1 response

Table 6.28 Range in rating of Auckland train stations

	Attribute Rating														Sample*	
Station	WP	Seat	Plat	OnOf	Info	Lght	C&G	Toil	Stff	Ret	Tick	Car	Bus	All	WP	All
Maximum	77%	74%	85%	88%	78%	79%	85%	71%	75%	64%	76%	76%	86%	79%	121	174
Station	KIN	NWL	ORA	MOR	REM	NEW	ORA	NEW	NEW	BRI	REM	HOM	KIN	NEW	ONE	BRI
Av (Station	57%	55%	68%	71%	64%	65%	67%	39%	47%	32%	58%	52%	56%	62%	39	39
Av (Resp)	60%	57%	69%	71%	66%	67%	69%	44%	54%	35%	59%	58%	61%	66%	1,117	1,443
Minimum	36%	30%	40%	40%	36%	38%	36%	0%	0%	0%	38%	23%	25%	33%	3	3
Station	WAK	PNM	TAN	PNM	MTA	PNM	TAN	TEM	TEM	TEM	AVO	MTE	MEA	TEM	TEM	TEM

There was no rating of Grafton station

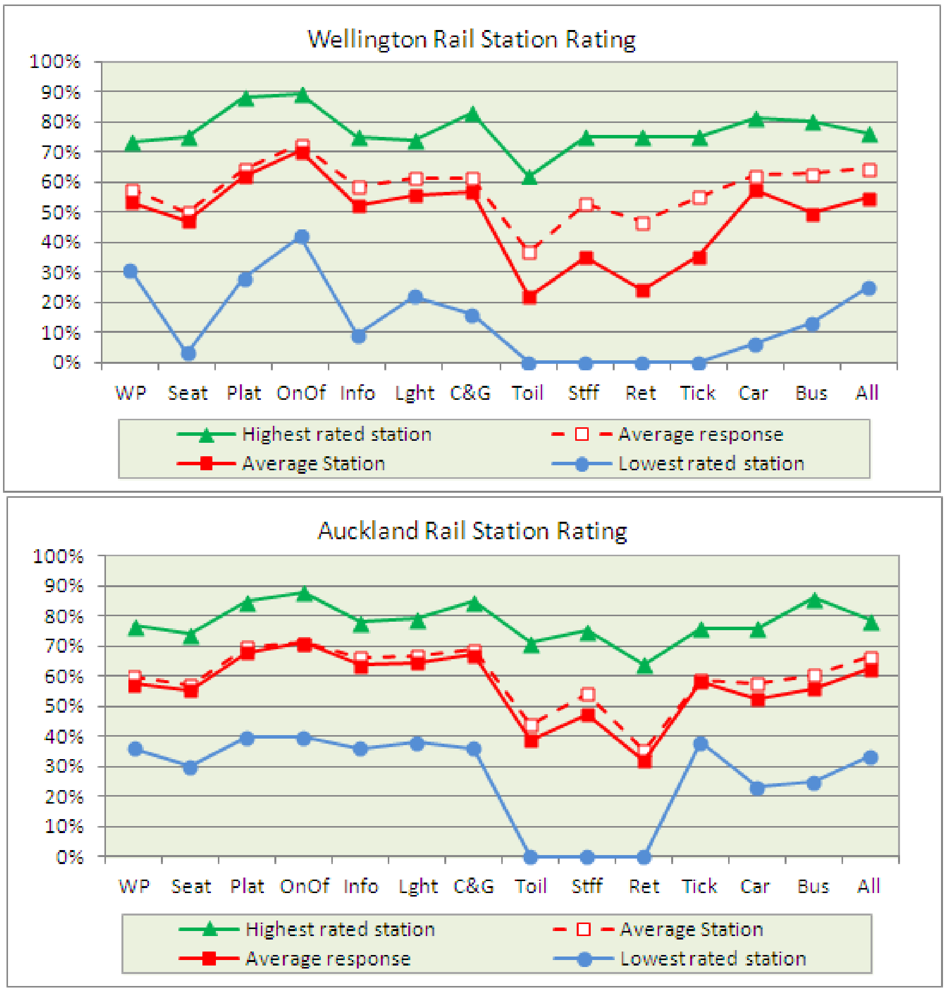
There was a marked range in the overall (All) rating. The top station in Auckland was Newmarket which scored 79% and in Wellington Waikanae received the highest rating of 76%. Both stations had been substantially upgraded; Newmarket was rebuilt in 2010 and effectively a new station was built at Waikanae in 2011 with the extension of electrification.

The lowest rated stations were Ava in Wellington which scored 25% and Te Mahia in Auckland which scored 33%. The Te Mahia score, however, was based on only three respondents. The next lowest with overall ratings in the low 40 percents and with more than 20 respondents were Takanini and Panmure.

Two measures of the average rating are presented in table 6.27 and figure 6.26. One measure is calculated as the average rating over all respondents. The other measure is the average over all stations. The second measure gives equal weight to stations irrespective of the number of responses. Given that higher use stations tend to have more and often better quality facilities, the average response ratings tended to be higher than the average station ratings.

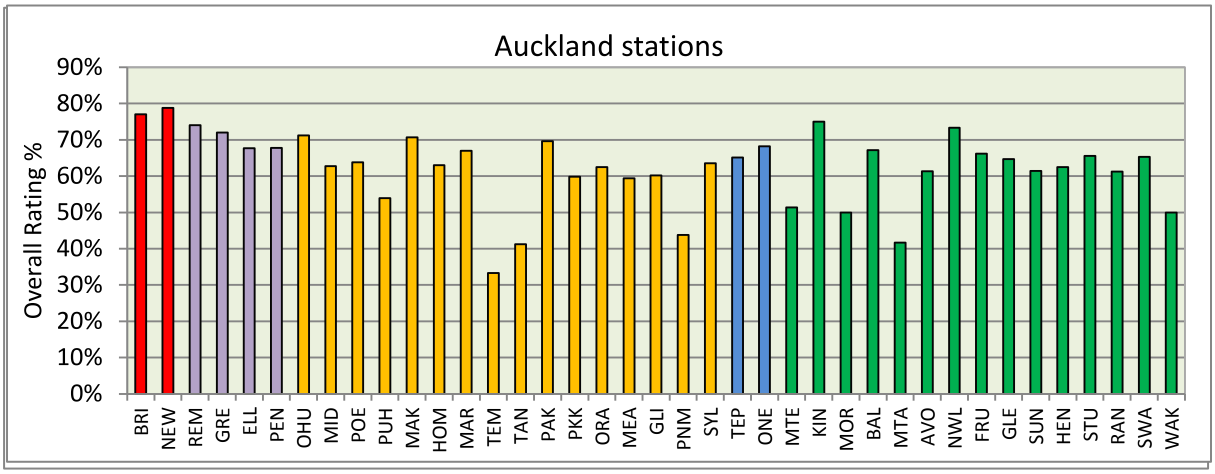
Comparing Auckland and Wellington, the average overall respondent ratings were close at 64% for Wellington and 66% for Auckland. There was a bigger 7% point difference in the average station rating with Wellington stations averaging 55% and Auckland 62%. The higher Auckland rating can be attributed to the extensive upgrade programme that has improved 35 of the 41 stations.

Figure 6.26 Range in train station attribute ratings



Across the attributes, ease of getting on and off the platform scored highly in both Auckland and Wellington with scores of 70%. There was also negligible difference in the average respondent and average station ratings. There was nevertheless a wide range in the on/off rating from a low of 42% at Ngauranga (which has access via a tunnel then a subway) to the highest rated station of Renall Street which scored 89% reflecting the single platform and low ramp to the nearby street.

Figure 6.27 Overall rating by station



Platform surface also scored well at around 60% in Wellington. Car parking scored around 60% in Wellington but less at 52% in Auckland. Car parking was in fact the only attribute where Auckland stations scored a lower rating than Wellington. The difference was most pronounced for ticket purchase with Auckland averaging 58% compared with 35% for Wellington, due in part to the introduction in Auckland of the HOP card.

Three attributes were consistently given low ratings: availability and cleanliness of toilets; the availability and helpfulness of staff; and retail facilities. The low ratings reflected their unavailability at many stations.

Weather protection had less variability than seating and platform surface. In Wellington, all the stations apart from Kaiwharawhara have a shelter on the platform. Unsurprisingly therefore, Kaiwharawhara rated the lowest at 31%. The highest rated station was Waterloo at 73%. Waterloo is completely roofed although it can be windy as the open ends create a wind tunnel effect. In Auckland, Kingsland which had a new shelter erected in 2011 for the rugby world cup rated highest at 77%. One point behind was the underground station of Britomart. The lowest rated station was Waitakere which scored 36%. Waitakere is planned to close once the new electric trains are operational.

The attribute ratings were correlated as can be seen from table 6.29. Stations that rated highly in one attribute tended to rate highly in another; conversely stations that rated lowly in one attribute rated lowly in another. Thus in Wellington, Petone station which was rebuilt in 2003 with further improvements made in 2010 scored consistently highly. There were some variations in ratings, however, such as Waikanae which scored highly in ease of platform on/off and cleanliness and graffiti but only modestly in terms of the weather protection and seating of the new platform shelters.

The highest correlation (0.9) was between lighting and the overall rating. The second highest correlation (0.86) was between staff and toilets and the third (0.83) was between staff and retail (the ability to buy food, drinks and newspapers etc).

Table 6.29 Correlation in station ratings

Attribute	Code	WP	Seat	Plat	OnOf	Info	Lght	C&G	Toil	Stff	Ret	Tick	Car	Bus	All
Weather Prot	WP	1	0.77	0.66	0.56	0.67	0.73	0.62	0.63	0.59	0.49	0.46	0.36	0.59	0.77
Seating	Seat	0.77	1	0.66	0.63	0.73	0.78	0.55	0.53	0.53	0.39	0.48	0.25	0.43	0.73
Platform Surf	Plat	0.66	0.66	1	0.67	0.66	0.79	0.79	0.43	0.41	0.27	0.39	0.36	0.36	0.80
Plat On/Off	OnOf	0.56	0.63	0.67	1	0.48	0.60	0.56	0.27	0.26	0.26	0.31	0.47	0.33	0.58
Information	Info	0.67	0.73	0.66	0.48	1	0.76	0.57	0.60	0.64	0.52	0.65	0.33	0.51	0.77
Lighting	Lght	0.73	0.78	0.79	0.60	0.76	1	0.79	0.73	0.66	0.52	0.56	0.37	0.56	0.90
Clean & Graf	C&G	0.62	0.55	0.79	0.56	0.57	0.79	1	0.60	0.52	0.42	0.51	0.35	0.46	0.79
Toilets	Toil	0.63	0.53	0.43	0.27	0.60	0.73	0.60	1	0.86	0.77	0.73	0.36	0.66	0.77
Staff	Stff	0.59	0.53	0.41	0.26	0.64	0.66	0.52	0.86	1	0.83	0.79	0.42	0.67	0.77
Retail	Ret	0.49	0.39	0.27	0.26	0.52	0.52	0.42	0.77	0.83	1	0.76	0.43	0.63	0.68
Ticketing	Tick	0.46	0.48	0.39	0.31	0.65	0.56	0.51	0.73	0.79	0.76	1	0.25	0.57	0.62
Car Parking	Car	0.36	0.25	0.36	0.47	0.33	0.37	0.35	0.36	0.42	0.43	0.25	1	0.48	0.53
Bus Transfer	Bus	0.59	0.43	0.36	0.33	0.51	0.56	0.46	0.66	0.67	0.63	0.57	0.48	1	0.61
All	All	0.77	0.73	0.80	0.58	0.77	0.90	0.79	0.77	0.77	0.68	0.62	0.53	0.61	1

The three lowest correlations were between car parking and seating (0.25); between car parking and ticketing (0.25); and between retailing and the ease of getting on and off the platform (0.26).

6.21 Station ratings and station classification

The six hub stations achieved higher ratings than the major and local stations, which matches the range of facilities provided.[53] There was less difference between major and local stations.

Table 6.30 and figure 6.28 present the average station rating (ie not weighted by survey response). Hub stations average 74% in the overall rating compared with 60% for the 19 major stations.

The 62 local stations (including stations classed as intermediate in Auckland) scored 56%. Thus there was only a 4% point difference between major and local stations.

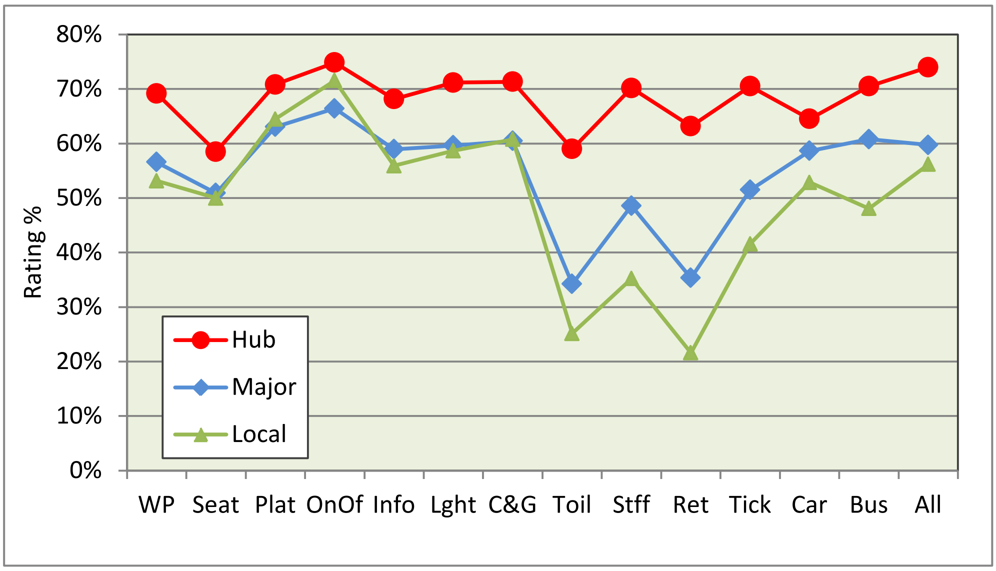
Table 6.30 Average station ratings by class of station

Class	WP	Seat	Plat	OnOf	Info	Lght	C&G	Toil	Stff	Ret	Tick	Car	Bus	All	Obs
Hub	69%	59%	71%	75%	68%	71%	71%	59%	70%	63%	71%	65%	71%	74%	6
Major	57%	51%	63%	66%	59%	60%	60%	34%	49%	35%	51%	59%	61%	60%	19
Local	53%	50%	64%	72%	56%	59%	61%	25%	35%	22%	42%	53%	48%	56%	62

Note 85 stations with ratings for individual attributes (Manor Park, Matarawa zero)

[53] For Auckland, intermediate and local stations were grouped and called local.

Figure 6.28 Average station ratings by class of station



The biggest rating advantage for hub stations was for toilets, staff and retail facilities. Hub stations averaged 59% for toilets, 71% for staff and 63% for retail facilities. The ratings were 20% to 30% points higher than those for major stations and more than double the average for local stations.

There was much less difference in platform surface, ease of on/off and car parking. In terms of ease of platform on/off, hub stations scored 75% with local stations rating higher (72%) than major stations at (66%).

Hub stations averaged 65% in car parking. There were effectively two groups however. There were three stations with large commuter car parks which were all in the Wellington region: Paraparaumu (73%) Porirua (73%) and Waterloo (71%) and three stations without large car parks: Wellington (57%) Britomart (61%) and Newmarket (64%). Major stations scored 59% in terms of car parking with local stations rating at 53%.

Hub stations scored the highest (70%) in bus transfer facilities, which reflects their interchange role. Waterloo scored highest at 74% despite the somewhat shabby state of the bus shelters (see photograph) with Porirua second at 73%. Major stations averaged 61% and local stations only 48%.

6.22 Station attribute ratings with attribute availability

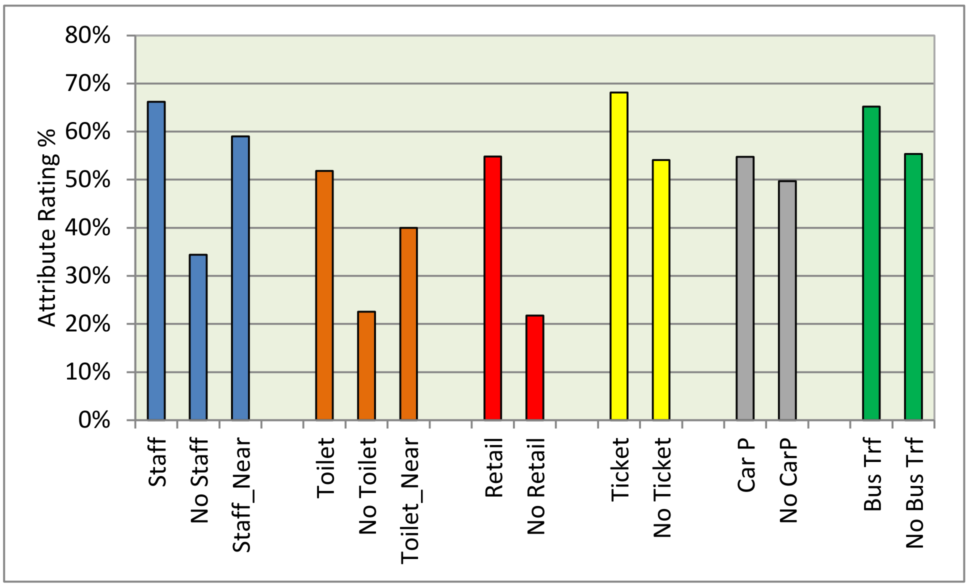
The average station rating, calculated according to facility availability is presented in table 6.31 and figure 6.29. The expectation was that the ratings would be low for those attributes where facilities were not provided. However although the ratings were lower the difference was not great.

Table 6.31 Average station ratings by attribute availability

Attribute	Attribute rating (%)					
	Staff	Toilet	Retail	Ticket	Car park	Bus transfer
Available	66%	52%	55%	68%	55%	65%
Not available	34%	23%	22%	54%	50%	55%
Nearby	59%	40%	na	na	na	na
All	41%	30%	28%	46%	52%	58%

Attribute	Attribute rating (%)					
	Staff	Toilet	Retail	Ticket	Car park	Bus transfer
	Number of stations					
Available	16	18	15	10	49	25
Not available	70	65	72	38	38	62
Nearby	1	4	na	na	na	na
All	87	87	87	48	87	87

Figure 6.29 Average station attribute ratings by availability



The 16 stations where staff were available (some or all of the time) scored 66% in *availability and helpfulness of staff* which was nearly double the rating of achieved by the 70 unmanned stations (34%). Manukau station, which was classified by AT as having *staff nearby*, scored 59%.

The 18 stations with toilets averaged 52% in *toilet availability and cleanliness* compared with 23% at stations without facilities and 40% at the four Auckland stations with toilets nearby. The highest rating was at Kingsland (65%) followed by Paraparaumu (62%).

Retailing/cafe facilities rated at 55% at the 15 stations with facilities compared with 22% at the 72 stations without.

There was less difference in the *ticketing* rating between stations with facilities (68%) and those without (54%).

The rating of *car parking and car passenger pick up and set down facilities* at the 49 stations with a car park averaged 55% compared with 50% at the 38 stations with only street parking.

There was a wider 10% point difference in the rating of *bus transfer facilities*. Stations with *bus transfer facilities* scored 65% compared with 55% 'without' (although some stations did have a bus stop nearby).

6.23 Platform access and station design

There was little difference in the *ease of getting to and from the platform* according to whether the station had flat access, an overbridge or a subway. The 36 stations with flat access (ie access/egress did not involve using an overbridge or a subway) rated the highest averaging 73%. The 28 stations with an overbridge rated at 69% and the 13 stations with subway access rated at 70%. There were also stations with two types of access but the sample sizes were small.

Table 6.32 Average station ratings by attribute availability

Type	Type	Platform access	Stats
Flat	Flat access station	73%	36
O	Overbridge	69%	28
S	Subway	70%	13
F&O	Flat and overbridge	70%	3
F&S	Flat and subway	74%	1
O&S	Overbridge and subway	69%	3
U	Underground	71%	1
-	All	71%	85

Passenger lifts have been installed at eight Auckland stations and four stations also have escalators. The provision of both lifts and escalators raised the rating for stations with an overbridge to 74% which was 6% points higher than the 23 stations with only stairs or a ramp to the overbridge (68%). With only lifts provided, the rating reduced to 70% which was 2% points higher than stations with stair/ramp access to an overbridge. Escalators therefore had the greatest rating effect.

Britomart, an underground station with lifts and escalators rated at 71% which was higher than Wellington train station (68%) which has a 'flat walk' through the main station concourse (with only two steps onto the street).

Table 6.33 Effect of lifts and escalators on ease of platform access/egress

Platform access	Rating	Stations
Overbridge with lift and escalator	74%	3
Overbridge with lift	70%	2
Underground with lift and escalator	71%	1
Overbridge stairs/ramp only	68%	23

6.24 Station upgrading

Most of the stations that had been recently upgraded were in Auckland where an extensive programme had taken place partly in preparation for electrification and also as part of the 2011 Rugby World Cup.

Several Wellington stations had been renovated such as Carterton, Woodside and those on the Johnsonville line, but the improvements were judged to be minor rather than major upgrades.[54]

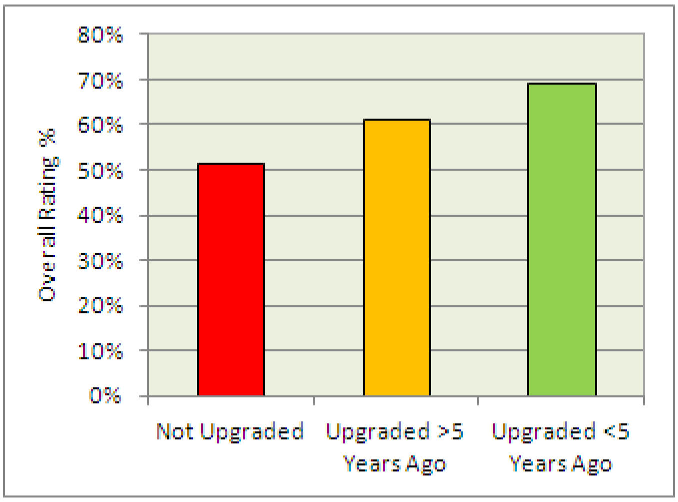
In total, 35 stations were judged to have had a major upgrade. These were split into 17 stations that had been upgraded within five years of the survey and 18 stations that had been upgraded within 5–10 years of the survey (including Britomart which had been constructed from new). The other 43 stations had not been upgraded. Table 6.34 presents the ratings by year of upgrade.

Table 6.34 Overall station ratings with station upgrading

Upgrade	Rating	Stations
No major upgrade	51%	43
Upgrade/new 5–10 years ago	61%	17
Upgrade/new in last 5 years	69%	18
Average rating	58%	87

The newly upgraded stations rated the highest at 69% followed by the recently upgraded at 61% and the non-upgraded at 51%. The step-like progression is shown in figure 6.30.

Figure 6.30 Overall station ratings with station upgrading



6.25 The effect of passenger profile on station ratings

The train station ratings were assessed by time of travel, journey purpose, gender, socio-economic status, age group and frequency of use. Sections 6.25.1 to 6.25.10 analyse each segmentation in turn.

6.25.1 Time period

Weekend train users and off-peak respondents rated higher than peak respondents.[55] The overall weekend rating was 70% compared with 63% for weekday peak respondents.

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[54] Table 6.22 (Wellington) and table 6.23 (Auckland) provide the dates when major station upgrades were undertaken. The Wellington upgrades are reviewed in section 6.21 in a 'before and after' analysis.

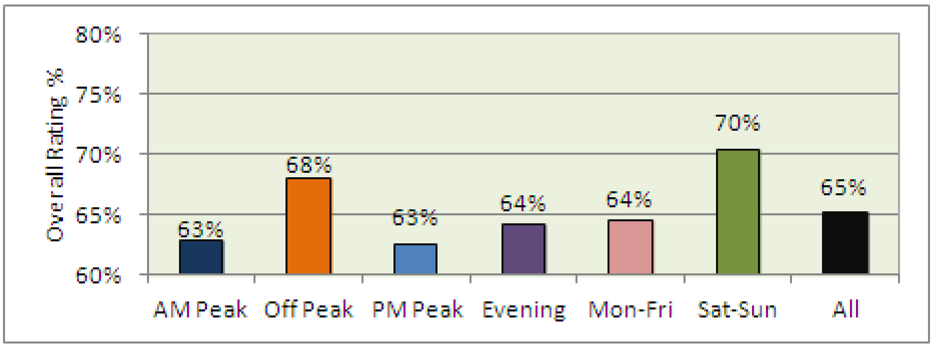
[55] There was overlap since the time period classification included weekend response.

The range in the attribute ratings was greatest for *toilets* with a weekend rating of 50% compared with 34% in the PM. The range was smallest (5% points) for *cleanliness and graffiti*.

Table 6.35 Station ratings by time period

Time Period	Rating (%)														Sample Size	
	WP	Seat	Plat	OnOf	Info	Lght	C&G	Toil	Stff	Ret	Tick	Car	Bus	All	WP	All
AM Peak	58%	51%	65%	73%	60%	63%	65%	36%	53%	47%	57%	61%	64%	63%	754	1,138
Off Peak	61%	56%	67%	72%	64%	65%	65%	45%	56%	44%	60%	62%	64%	68%	1,505	2,088
PM Peak	54%	48%	64%	71%	57%	60%	62%	34%	49%	39%	51%	59%	58%	63%	1,008	1,351
Evening	59%	52%	66%	73%	62%	63%	62%	40%	50%	37%	53%	60%	61%	64%	144	201
Mon-Fri	58%	52%	65%	72%	61%	63%	63%	38%	52%	43%	56%	60%	61%	64%	3,046	4,253
Sat-Sun	65%	59%	69%	75%	66%	67%	67%	50%	60%	46%	63%	66%	69%	70%	365	525
All	58%	52%	66%	72%	61%	63%	64%	39%	53%	43%	56%	61%	62%	65%	3,411	4,778
High	SaSu	SaSu	SaSu	SaSu	SaSu	SaSu	SaSu	SaSu	SaSu	AM	SaSu	SaSu	SaSu	SaSu	na	na
Low	PM	PM	PM	PM	PM	PM	PM	PM	PM	EV	PM	PM	PM	PM	na	na
Range	11%	11%	5%	4%	9%	7%	5%	16%	11%	10%	12%	7%	11%	8%	na	na

Figure 6.31 Station ratings by time period



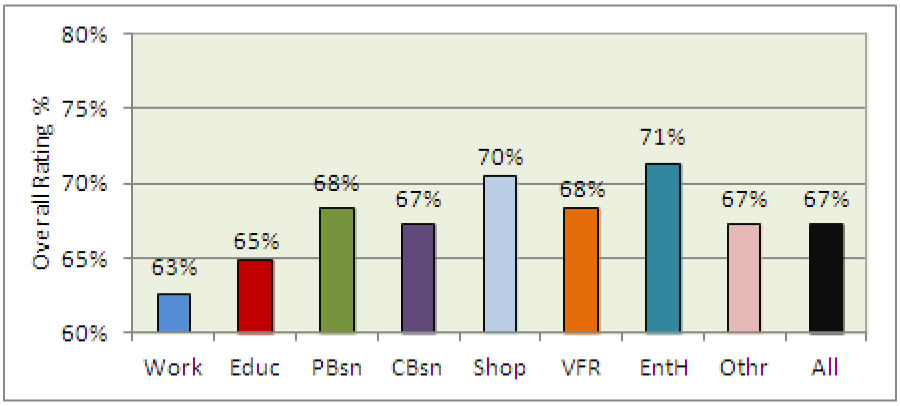
6.25.2 Trip purpose

There was greater variation in the station than bus stop ratings by trip purpose. Respondents commuting to or from work tended to give the lowest ratings (63%), with entertainment/holiday (71%) and shopping (70%) respondents rating stations higher. Respondents on company business trips also tended to rate higher than commuters, which probably reflects a greater use of larger CBD stations.

Table 6.36 Train station attribute ratings by journey purpose

Trip Purpose	Rating (%)														Sample Size	
	WP	Seat	Plat	OnOf	Info	Lght	C&G	Toil	Stff	Ret	Tick	Car	Bus	All	WP	All
Work	55%	49%	64%	72%	58%	61%	63%	35%	51%	42%	53%	60%	60%	63%	1,878	2,688
Education	58%	53%	67%	73%	63%	63%	62%	36%	51%	39%	56%	60%	62%	65%	363	516
Pers Bsn	63%	55%	67%	72%	66%	66%	67%	48%	57%	48%	63%	63%	65%	68%	213	285
Comp Bsn	67%	61%	64%	71%	67%	71%	68%	52%	56%	53%	60%	65%	70%	67%	35	66
Shopping	64%	58%	69%	71%	68%	68%	67%	50%	61%	46%	62%	64%	67%	70%	281	336
VFR	65%	58%	69%	74%	64%	64%	63%	43%	57%	46%	63%	65%	66%	68%	240	361
Ent/Hol	64%	61%	69%	72%	67%	67%	68%	51%	58%	43%	63%	61%	65%	71%	308	410
Other	59%	52%	64%	69%	58%	60%	65%	42%	58%	48%	59%	62%	64%	67%	69	79
All	59%	52%	66%	72%	61%	63%	64%	39%	53%	43%	56%	61%	62%	67%	3,388	4,744
High	CBsn	CBsn	Shop	VFR	Shop	CBsn	CBsn	CBsn	Shop	CBsn	PBsn	CBsn	CBsn	EntH	na	na
Low	Work	Work	Work	Othr	Work	Othr	Educ	Work	Work	Educ	Work	Work	Work	Work	na	na
Range	12%	12%	5%	5%	10%	11%	6%	17%	10%	14%	10%	5%	10%	9%	na	na

Figure 6.32 Overall train station rating by journey purpose



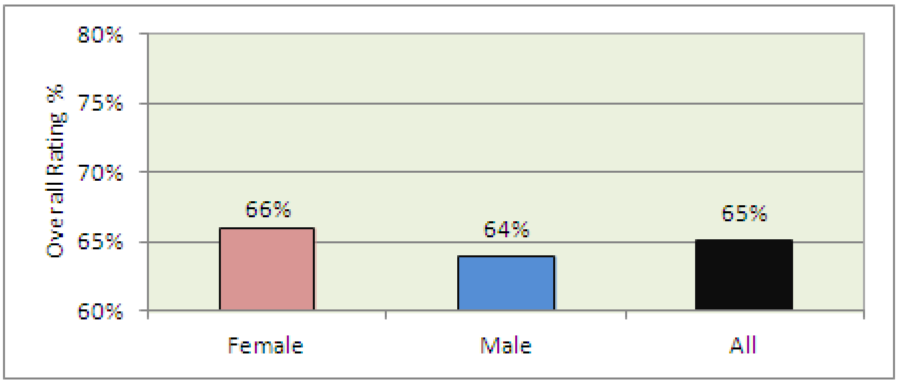
6.25.3 Gender

There was little difference in the ratings by gender. There was a 2% point difference in the overall rating (66% female and 64% male). The greatest difference was for *retail provision* with females rating at 46% compared with 41% for males.

Table 6.37 Train station ratings by gender

Gender	Rating (%)															
	WP	Seat	Plat	OnOf	Info	Lght	C&G	Toil	Stff	Ret	Tick	Car	Bus	All	WP	All
Female	58%	53%	66%	72%	62%	63%	64%	41%	55%	46%	57%	61%	62%	66%	1,762	2,543
Male	59%	51%	65%	72%	60%	63%	63%	37%	51%	41%	55%	60%	62%	64%	1,462	2,044
All	58%	52%	66%	72%	61%	63%	63%	39%	53%	43%	56%	61%	62%	65%	3,224	4,587
Max	M	F	F	M	F	M	F	F	F	F	F	F	M	F	na	na
Range	1%	2%	1%	0%	2%	0%	1%	4%	4%	5%	2%	1%	0%	2%	na	na

Figure 6.33 Overall train station ratings by gender



6.25.4 Socio-economic status

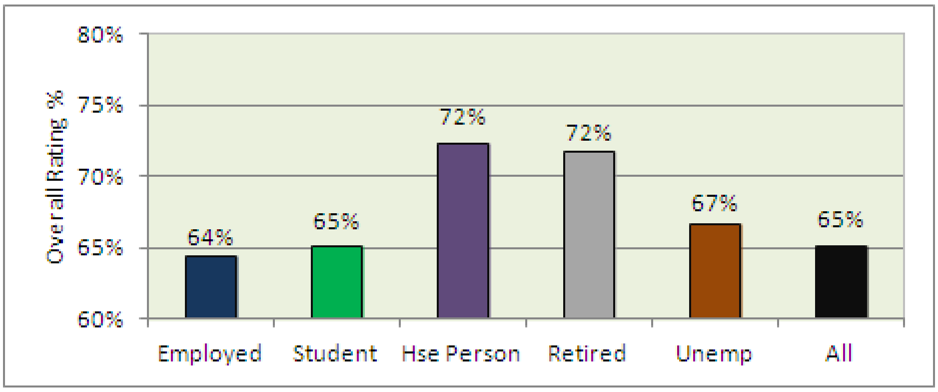
House persons and retired passengers (72%) tended to rate higher than employed passengers (64%), students (65%) and unemployed (67%) respondents. The lower employed rating follows the lower peak and lower commuting to work ratings.

The greatest difference was for *toilets* with house persons rating 20% points higher than employed passengers. The smallest difference was for *ease of getting on/off the platform*.

Table 6.38 Train station ratings by socio-economic status

Socio-Econ Status	Rating (%)														Sample Size	
	WP	Seat	Plat	OnOf	Info	Lght	C&G	Toil	Stff	Ret	Tick	Car	Bus	All	WP	All
Employed	57%	50%	65%	72%	59%	62%	64%	38%	52%	43%	55%	61%	61%	64%	2,188	3,194
Student	59%	54%	66%	72%	63%	62%	60%	40%	52%	42%	56%	60%	62%	65%	809	1,064
Hse Person	69%	64%	70%	73%	67%	73%	75%	58%	61%	50%	65%	66%	72%	72%	59	84
Retired	66%	62%	73%	73%	70%	71%	73%	53%	66%	47%	68%	64%	72%	72%	211	245
Unemp	58%	54%	61%	69%	60%	63%	59%	39%	54%	43%	52%	57%	60%	67%	75	114
All	58%	52%	66%	72%	61%	63%	64%	39%	53%	43%	56%	61%	62%	65%	3,342	4,701
High	HPr	HPr	Ret	HPr	Ret	HPr	HPr	HPr	Ret	HPr	Ret	HPr	HPr	HPr	na	na
Low	Emp	Emp	UnE	UnE	Emp	Emp	UnE	Emp	Emp	Std	UnE	UnE	UnE	Emp	na	na
Range	12%	14%	12%	4%	11%	11%	16%	20%	14%	8%	16%	9%	12%	8%	na	na

Figure 6.34 Overall train station rating by socio-economic status



6.25.5 Personal income

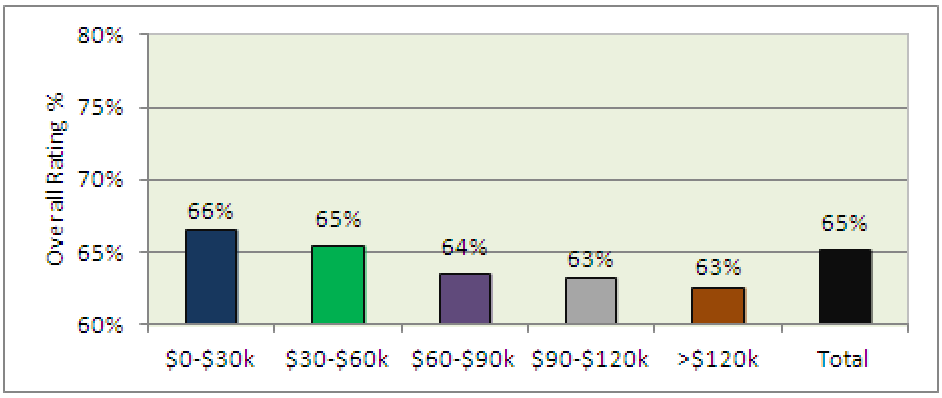
The train station ratings were compared against personal income (albeit a synthetic profile).

The overall station rating declined with income from a high of 66% for the lowest ($0–30,000) annual gross personal income category down to a low of 63% for the highest income category (over $120,000). The range was not wide however.

Table 6.39 Train station ratings by personal income

Personal Income	Rating (%)														Sample Size	
	WP	Seat	Plat	OnOf	Info	Lght	C&G	Toil	Stff	Ret	Tick	Car	Bus	All	WP	All
$0-$30k	60%	54%	67%	72%	63%	64%	64%	42%	55%	44%	58%	61%	63%	66%	1,439	1,893
$30-$60k	57%	52%	65%	72%	62%	64%	65%	41%	54%	44%	57%	61%	62%	65%	922	1,312
$60-$90k	57%	51%	64%	71%	59%	61%	62%	34%	50%	41%	54%	61%	59%	64%	584	857
$90-$120k	60%	52%	65%	73%	58%	63%	65%	38%	51%	40%	54%	58%	60%	63%	276	427
>$120k	53%	46%	63%	70%	54%	60%	60%	36%	50%	41%	54%	59%	58%	63%	190	289
Total	58%	52%	66%	72%	61%	63%	64%	39%	53%	43%	56%	61%	62%	65%	3,411	4,778
High	0-30	0-30	0-30	90-120	0-30	0-30	30-60	0-30	0-30	0-30	0-30	0-30	0-30	0-30	na	na
Low	>120	>120	>120	>120	>120	>120	>120	60-90	60-90	90-120	60-90	90-120	>120	>120	na	na
Range	7%	8%	4%	3%	9%	4%	5%	8%	5%	4%	4%	3%	5%	4%	na	na

Figure 6.35 Overall train station rating with personal income



6.25.6 Respondent age

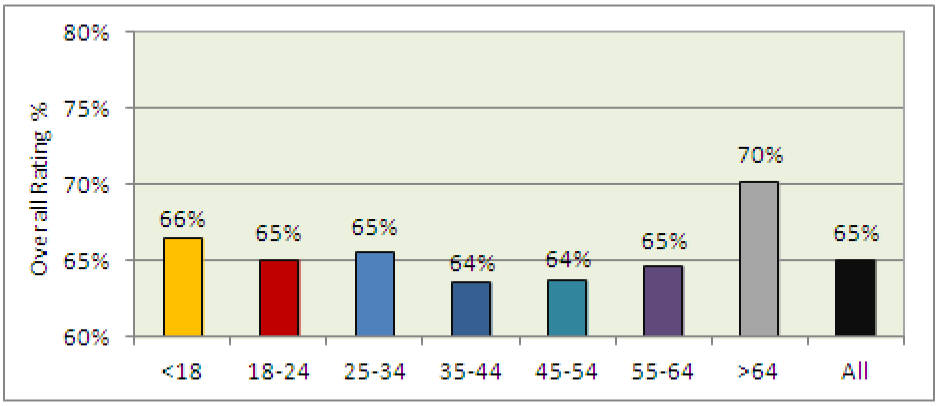
Older respondents tended to rate higher (the same as for the bus stop and vehicle ratings. For the overall rating, over 64s rated at 70% compared with 64%–67% for younger age groups.

The difference was most pronounced for *cleanliness and graffiti* with over 64 year olds giving a rating of 73% compared with 56% from under 18 year olds.

Table 6.40 Train station ratings by age group

Age Group	Rating (%)														Sample Size	
	WP	Seat	Plat	OnOf	Info	Lght	C&G	Toil	Stff	Ret	Tick	Car	Bus	All	WP	All
<18	60%	54%	64%	72%	62%	60%	56%	39%	51%	42%	56%	60%	62%	66%	356	463
18-24	57%	53%	66%	73%	63%	62%	62%	38%	53%	43%	58%	61%	62%	65%	726	1,020
25-34	58%	53%	66%	72%	60%	63%	64%	39%	52%	42%	55%	60%	61%	65%	606	848
35-44	57%	50%	64%	71%	59%	61%	63%	37%	51%	42%	52%	58%	61%	64%	579	847
45-54	58%	51%	64%	70%	58%	63%	64%	38%	52%	44%	55%	60%	59%	64%	472	730
55-64	57%	49%	66%	71%	61%	66%	66%	40%	55%	44%	58%	64%	61%	65%	349	487
>64	65%	61%	72%	75%	68%	72%	73%	53%	63%	47%	66%	66%	71%	70%	256	310
All	58%	52%	66%	72%	61%	63%	64%	39%	53%	43%	56%	61%	62%	65%	3,344	4,705
High	>64	>64	>64	>64	>64	>64	>64	>64	>64	>64	>64	>64	>64	>64	na	na
Low	18-24	55-64	<18	45-54	45-54	<18	<18	35-44	<18	<18	35-44	35-44	45-54	35-44	na	na
Range	8%	12%	8%	5%	10%	12%	17%	16%	12%	5%	14%	8%	12%	7%	na	na

Figure 6.36 Train station ratings by age group



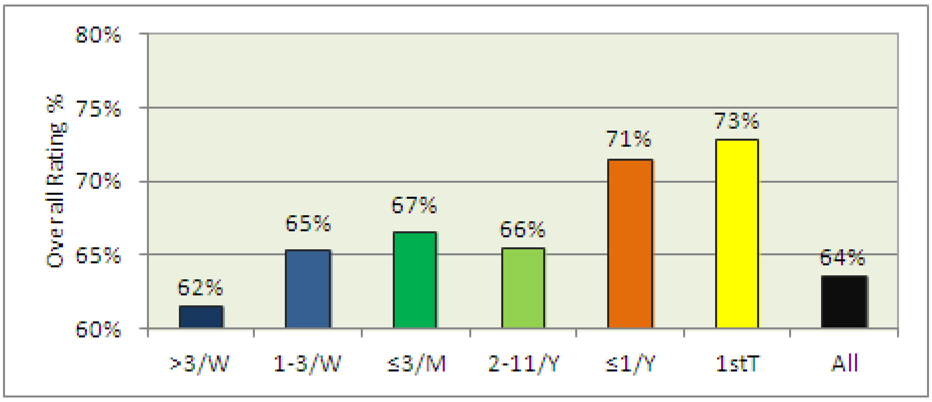
6.25.7 Frequency of use

First time and occasional users tended to rate higher (71%–73%) than frequent users (62%).

Table 6.41 Train station ratings by frequency of use

Frequency of Use	Rating (%)														Sample Size	
	WP	Seat	Plat	OnOf	Info	Lght	C&G	Toil	Stff	Ret	Tick	Car	Bus	All	WP	All
>3Days/Wk	56%	49%	65%	72%	59%	62%	62%	35%	51%	42%	54%	60%	60%	62%	1,976	1,966
1-3Days/Wk	60%	55%	68%	74%	64%	65%	64%	38%	50%	41%	57%	63%	63%	65%	516	507
1-3Dys/Mnth	62%	57%	67%	72%	65%	64%	64%	44%	57%	42%	61%	62%	66%	67%	353	353
2-11Days/Yr	63%	57%	67%	71%	64%	65%	66%	50%	58%	46%	60%	62%	63%	66%	314	301
<=Once/Yr	68%	61%	69%	73%	68%	69%	70%	59%	64%	54%	64%	65%	70%	71%	99	96
1stTime	69%	62%	69%	72%	64%	75%	76%	65%	70%	58%	70%	64%	67%	73%	71	67
All	58%	52%	66%	72%	61%	63%	64%	39%	53%	43%	56%	61%	62%	64%	3,329	3,290
High	1stT	1stT	≤1/Y	1-3/W	≤1/Y	1stT	1stT	1stT	1stT	1stT	1stT	≤1/Y	≤1/Y	1stT	na	na
Low	>3/W	>3/W	>3/W	2-11/Y	>3/W	>3/W	>3/W	>3/W	1-3/W	1-3/W	>3/W	>3/W	>3/W	>3/W	na	na
Range	13%	13%	4%	3%	9%	13%	14%	30%	20%	17%	16%	5%	10%	11%	na	na

Figure 6.37 Overall train station rating by frequency of use



6.25.8 Light and weather conditions

Whether it was light or dark did not affect the overall rating with both response groupings scoring 65%. There was a difference in the *lighting* rating with passengers surveyed when it was dark giving ratings 4% points higher than passengers surveyed when it was light.

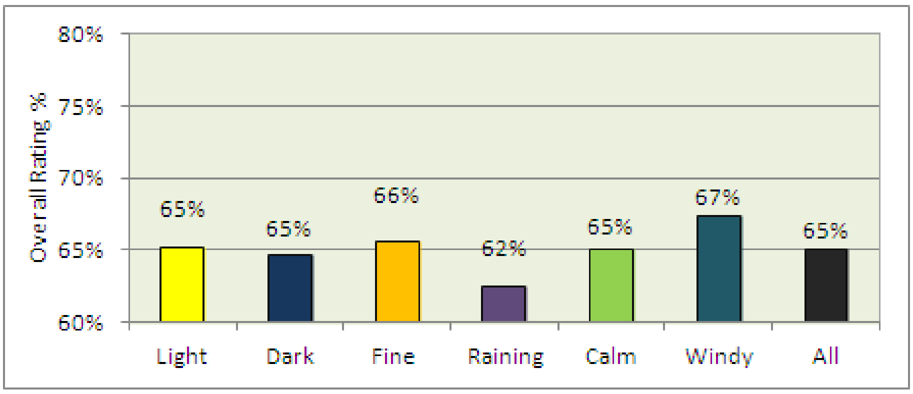
Passengers surveyed when it was raining gave ratings 4% points lower than when it was fine. For *weather protection*, the ratings were 59% when it was fine and 56% when it was raining.

There were too few observations to assess the effect of wind.

Table 6.42 Bus stop ratings with lighting and weather conditions

	Rating (%)														Sample Size	
	WP	Seat	Plat	OnOf	Info	Lght	C&G	Toil	Stff	Ret	Tick	Car	Bus	All	WP	All
Light	58%	52%	65%	72%	61%	63%	63%	39%	53%	44%	56%	61%	62%	65%	3,172	4,457
Dark	59%	56%	69%	73%	65%	67%	70%	39%	51%	32%	57%	58%	62%	65%	239	321
Fine	59%	53%	66%	72%	62%	64%	64%	40%	54%	43%	57%	60%	62%	66%	2,905	4,123
Raining	56%	49%	63%	71%	57%	60%	59%	35%	51%	42%	53%	63%	61%	62%	506	655
Calm	58%	52%	66%	72%	61%	63%	64%	40%	53%	43%	56%	61%	62%	65%	3,402	4,765
Windy	50%	53%	64%	65%	53%	56%	58%	23%	38%	24%	57%	60%	57%	67%	9	13
All	58%	52%	66%	72%	61%	63%	64%	39%	53%	43%	56%	61%	62%	65%	3,411	4,778

Figure 6.38 Overall bus stop rating with lighting and weather conditions



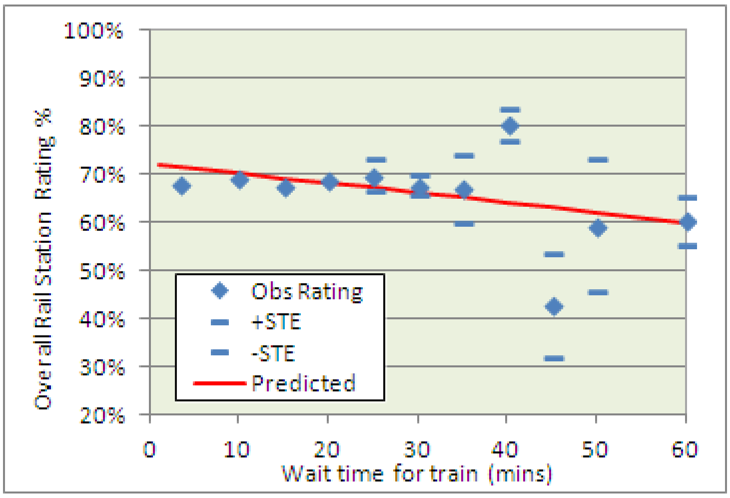
6.25.9 Waiting time at train stations

The length of wait affected the station ratings less than the bus stop ratings. For waits under half an hour, the overall rating averaged just under 70% with no consistent trend in the rating. There were few respondents who waited longer than half an hour so the sampling error was quite wide (figure 6.39).

Table 6.43 Overall train station ratings with wait time

Wait Time	Rating (%) WP	Seat	Plat	OnOf	Info	Lght	C&G	Toil	Stff	Ret	Tick	Car	Bus	All	Sample Size WP	All
3.3	62%	54%	69%	75%	63%	64%	67%	40%	56%	45%	61%	63%	66%	68%	603	1,489
10	64%	57%	70%	75%	64%	67%	70%	43%	56%	46%	61%	65%	67%	69%	322	600
15	62%	55%	68%	75%	65%	65%	65%	41%	58%	46%	65%	63%	69%	67%	110	211
20	66%	58%	69%	73%	66%	67%	64%	43%	60%	46%	59%	63%	65%	69%	96	139
25	63%	53%	73%	72%	67%	74%	85%	54%	61%	59%	70%	55%	66%	70%	21	37
30	66%	55%	68%	73%	69%	70%	70%	50%	61%	44%	68%	63%	64%	68%	47	79
35	61%	69%	69%	74%	59%	56%	64%	37%	43%	39%	66%	75%	72%	67%	10	11
40	74%	73%	78%	83%	65%	72%	75%	64%	69%	39%	76%	63%	81%	80%	11	14
45	21%	21%	42%	50%	17%	25%	50%	33%	25%	21%	50%	50%	25%	43%	3	7
50	44%	63%	69%	69%	63%	56%	13%	50%	56%	25%	25%	50%	56%	59%	2	4
60	63%	53%	65%	70%	84%	63%	73%	48%	50%	38%	53%	68%	73%	60%	5	6
Total	63%	55%	69%	75%	64%	65%	68%	42%	57%	46%	62%	63%	66%	68%	1,233	2,602

Figure 6.39 Overall train station rating with wait time



6.26 Train station access/egress mode

Rail respondents were asked how they had got to the station (inbound questionnaire) or how they would get from the station (outbound questionnaire).[56] A summary of the access/egress profile is presented in table 6.44 with detailed tabulations presented in appendix I (see part 3 of this report).

[56] The question was not included on the SP questionnaire.

The access/egress profiles were similar for Auckland and Wellington with over 50% walking. Across the stations, the walk percentage varied from 0% at Woodside and Solway (which are located a good distance from settlements) to 100% at Epuni and Te Mahia.

Table 6.44 Access mode share

Statistic	Wellington Access/Egress Mode Share								Obs
	Walk	Bike	Bus	Taxi	C&P	K&R	Trfr	Other	Obs
Maximum	100%	5%	24%	16%	70%	50%	4%	6%	48
Station	EPU	WOO	PAM	MAS	TAI	KAI	TAI	CAR	-
Av (Station)	60%	1%	4%	2%	22%	11%	0%	1%	48
Av (Resp)	54%	1%	8%	2%	23%	10%	1%	1%	2,272
# Stations 0% Use	2	31	25	33	8	10	41	33	48
	Auckland Access/Egress Mode Share								
Maximum	100%	7%	28%	5%	59%	50%	7%	17%	39
Station	TEM	PKK	HEN	MAR	PNM	HOM	PUH	ORA	-
Av (Station)	60%	1%	5%	0%	18%	12%	1%	3%	39
Av (Resp)	55%	1%	7%	1%	19%	13%	1%	3%	1,140
# Stations 0% Use	0	29	18	34	5	10	33	21	39

Around a quarter of Wellingtonians and a fifth of Aucklanders parked their car at the station. A further 10% of Wellington and 13% of Auckland respondents got a lift. Thus around a third used a car. The car share varied widely over the stations however. The park and ride share ranged from zero (eight Wellington and five Auckland stations had zero respondents who parked their car at the station) to 70% at Taita and 59% at Panmure. The kiss and ride share ranged from 0% at 10 stations to 50% at Kaiwharawhara (small sample) and 50% at Homai.

Bus use was much lower at less than 10%.

Despite the bicycle racks and lockers at nearly all train stations in Wellington, only 1% of respondents cycled to/from the station. The highest use was at Woodside in Wellington (5%) and Pukekohe in Auckland (7%).

Taxi use was also low (2% in Wellington).The highest share was at Masterton (16%), which is located about 1.5km from the town centre.

Few respondents transferred trains.

In terms of rating, taxi users, bus users and passengers transferring between trains tended to rate their station higher than car users as can be seen from table 6.45 and figure 6.40.

Bus users rated bus facilities higher than 'non' bus users.

Figure 6.41 graphs the car and bus ratings against the respective access mode share. The prediction equation (using a logistic form) is shown in table 6.46. As can be seen, both ratings increased with rising access share reflecting improved facilities. For car, the predicted rating increased from 40% with a zero car access share to 80% with a 100% share. For bus, the relationship was flatter reflecting lower access shares rising from 50% to 70%. It could be argued that the relationship should be the 'other way around' with better facilities encouraging greater use. Appendix J (see part 3 of this report) presents the 'converse' relationship.

Table 6.45 Overall train station ratings with access mode

Access/ Egress Mode	Rating (%)														Sample Size	
	WP	Seat	Plat	OnOf	Info	Lght	C&G	Toil	Stff	Ret	Tick	Car	Bus	All	WP	All
Walk	59%	53%	66%	73%	61%	64%	63%	38%	51%	42%	54%	58%	60%	63%	1,835	1,807
Bicycle	60%	51%	67%	72%	62%	68%	70%	41%	51%	48%	61%	64%	61%	65%	40	40
Bus	64%	55%	68%	73%	67%	69%	68%	52%	66%	57%	68%	64%	72%	69%	272	269
Taxi	56%	53%	69%	75%	61%	67%	65%	44%	53%	40%	56%	68%	69%	66%	43	43
C&P	54%	48%	63%	71%	58%	60%	63%	35%	51%	39%	55%	63%	62%	61%	732	722
K&R	58%	54%	65%	72%	61%	61%	63%	40%	56%	45%	61%	65%	64%	65%	380	375
Transfer	62%	50%	65%	68%	66%	67%	64%	49%	55%	52%	62%	65%	67%	70%	42	39
Other	58%	49%	62%	63%	62%	60%	61%	41%	54%	37%	53%	49%	57%	61%	42	41
Total	58%	52%	66%	72%	61%	63%	64%	39%	53%	43%	56%	61%	62%	64%	3,386	3,336
High	Bus	Bus	Taxi	Taxi	Bus	Bus	Bike	Bus	Bus	Bus	Bus	Taxi	Bus	Trf	na	na
Low	C&P	C&P	Oth	Oth	C&P	C&P	Oth	C&P	Walk	Oth	Oth	Oth	Oth	Oth	na	na
Range	10%	7%	7%	12%	9%	9%	9%	17%	15%	20%	15%	19%	15%	9%	na	na

Figure 6.40 Rating of car and bus transfer facilities by access mode

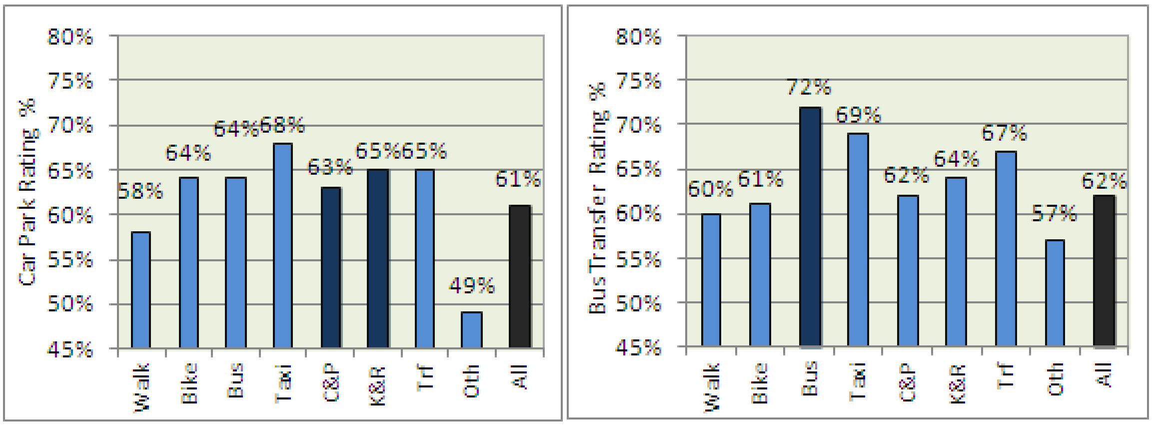
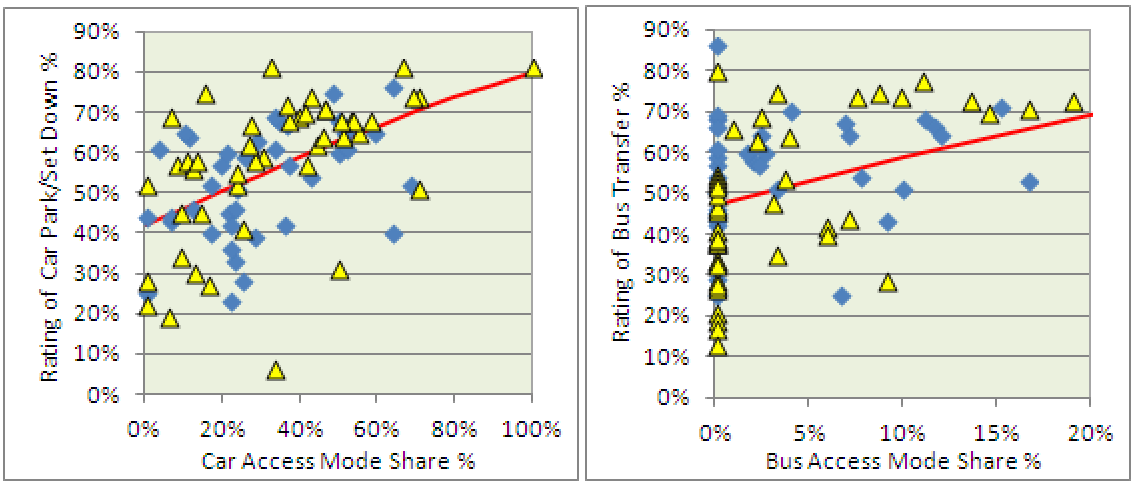


Table 6.46 Model parameter – rating of car and bus facilities on access mode share

	Parameter Estimate		Standard Error		|t| value	
	Intercept	Slope	Intercept	Slope	Intercept	Slope
Car	-0.326	1.679	0.12	0.30	2.8	5.6
Bus	-0.11	4.617	0.083	0.86	1.3	5.4

$$R\% = \frac{\exp(\beta o + \beta(CARACCESS))}{(1 + \exp(\beta o + \beta(CARACCESS)))} \quad \text{(Equation 6.1)}$$

Figure 6.41 Model parameter – rating of car and bus facilities on access mode share



Legend: yellow triangles denote Wellington rail stations and blue diamonds Auckland rail stations

6.27 Explanation of overall station rating using individual response data

Models (linear and logit) were fitted on the individual response data (4,778 observations) to explain the overall rating in terms of trip and socio-economic profile. Table 6.47 presents the thirteen models with the results reflecting the preceding aggregate analysis.

Going through the runs in turn, off-peak and weekend respondents (model 1) gave higher ratings, by around 4% points, than AM and PM peak users.

In terms of trip purpose (2), commuters gave lower ratings (by around 8% points) than respondents making other types of trip.

Females (3) rated their stations slightly higher than males (2% points).

Passengers aged over 64 (4) rated stations higher by around 7% points.

Retired passengers and house persons (5) also rated higher than employed respondents and students.

There was a tendency for the station rating to decline with personal income (6).

In terms of access mode (7), passengers transferring to (or from) bus rated train stations just under 4% higher than walkers but passengers who parked their car at the train station gave ratings that were typically 5% points lower. Some reasons were offered in section 6.21 but it is worth adding that car drivers are probably the most flexible since they have the ability to drive the whole trip.

Passengers who rarely used rail (8) rated the stations higher than regular users which accords with the higher 'discretionary' trip purpose ratings.

In terms of weather (9), rain reduced the overall rating but darkness and wind had no significant effect.

Hub train stations (10) were rated 10% points higher than major train stations and local stations were rated 4% lower.

Stations that had been upgraded (11) in the last decade rated 3.4% higher than those that had not been upgraded. Stations that had been upgraded in the last five years rated an additional 3.6% higher. Both uplifts were statistically significant.

Two wait time models were fitted (12 and 13). Ratings tended to be slightly lower for waits of 15 minutes or less and higher for waits above 30 minutes. The linear model (13) showed a general upwards trend with wait time.

A full model (14) was estimated that included all statistically significant segmentations:

- trips made in the off-peak were +2.6% in terms of the rating
- entertainment/holiday trips were +4%
- retired passengers were +5.7%
- house persons were +5.5%
- passengers driving to the station and parking their car were -2.4%
- hub stations were +14%
- local stations were -3.2%
- stations that had been upgraded in the last decade were +7.3%
- stations upgraded in the last five years were +13% (+5.7% on stations upgraded 5–10 years ago)

Thus the most powerful effects were hub stations and station upgrading with the magnitude of effect increased by the introduction of socio-economic and trip profile variables.

Table 6.47 Train station explanatory model

Model	Desc	Variable	Linear Beta	Linear STE	Linear |t|	Logit Beta	Logit STE	Logit |t|
1	Time Period (Base = AM Peak)	OFF PK	0.044	0.009	4.9	0.196	0.038	5.2
		PM PK	-0.005	0.009	0.6	-0.023	0.039	0.6
		EVENING	0.010	0.017	0.6	0.044	0.073	0.6
		WEEKEND	0.041	0.011	3.8	0.189	0.050	3.8
		CONSTANT	0.628	0.007	89.7	0.525	0.028	18.5
2	Trip Purpose (Base = Work)	EDUC	0.021	0.011	1.9	0.089	0.047	1.9
		PERS BUSN	0.055	0.014	3.9	0.243	0.064	3.8
		COMP BUSN	0.044	0.028	1.6	0.194	0.129	1.5
		SHOP	0.076	0.013	5.9	0.345	0.059	5.8
		VFR	0.056	0.013	4.3	0.247	0.055	4.5
		ENT/HOL	0.085	0.012	7.1	0.386	0.060	6.5
		CONSTANT	0.628	0.004	157.1	0.525	0.018	28.9
3	Gender (Base = Male)	FEMALE	0.018	0.007	2.8	0.080	0.029	2.8
		CONSTANT	0.642	0.005	133.8	0.572	0.021	27.1
4	Age Group (Base = 25-64)	UNDER 18	0.020	0.011	1.8	0.088	0.050	1.8
		AGE 18-24	0.006	0.008	0.7	0.027	0.037	0.7
		OVER 64	0.058	0.014	4.3	0.263	0.067	3.9
		CONSTANT	0.644	0.004	157.1	0.594	0.018	33.3
5	Socio-Economic Status (Base =Employed)	STUDENT	0.006	0.008	0.8	0.028	0.035	0.8
		HSEPERS	0.079	0.025	3.2	0.367	0.125	2.9
		RETIRED	0.073	0.015	4.9	0.336	0.077	4.4
		UNEMPLOYED	0.023	0.022	1.0	0.100	0.109	0.9
		CONSTANT	0.644	0.004	163.1	0.593	0.017	34.7
6	Personal Income $k p.a.	PY	-0.0004	0.000	4.2	-0.0016	0.000	4.2
		CONSTANT	0.670	0.006	121.1	0.706	0.025	28.5
7	Access/Egress Mode (Base = Walk)	BICYCLE	-0.010	0.036	0.3	-0.045	0.140	0.3
		BUS	0.037	0.014	2.6	0.169	0.067	2.5
		TAXI	0.006	0.035	0.2	0.025	0.123	0.2
		CAR&PARK	-0.050	0.009	5.4	-0.215	0.040	5.4
		CAR&LIFT	-0.010	0.012	0.8	-0.045	0.054	0.8
		TRANSFER	0.038	0.036	1.1	0.175	0.174	1.0
		CONSTANT	0.657	0.004	166.8	0.651	0.018	37.2
8	Frequency of Use (Base = Regular)	OCCASIONAL	0.007	0.014	0.5	0.031	0.061	0.5
		RARE	0.072	0.018	4.0	0.333	0.085	3.9
		CONSTANT	0.648	0.004	185.1	0.611	0.015	40.5
9	Light & Weather (Base = light, fine, calm)	DARK	-0.010	0.013	0.7	-0.043	0.060	0.7
		RAINING	-0.033	0.010	3.4	-0.143	0.043	3.3
		WINDY	0.050	0.063	0.8	0.219	0.214	1.0
		CONSTANT	0.656	0.004	177.4	0.646	0.016	40.4
10	Station Class (Base = Major)	HUB	0.099	0.008	12.4	0.458	0.037	12.4
		LOCAL	-0.039	0.008	4.9	-0.166	0.037	4.5
		CONSTANT	0.629	0.006	104.8	0.528	0.029	18.0
11	Station Upgrade (Base = not upgraded)	UPG10Y	0.034	0.009	3.9	0.152	0.038	4.0
		UPG≤5Y	0.036	0.011	3.2	0.165	0.049	3.4
		CONSTANT	0.634	0.004	157.6	0.547	0.018	30.4
12	Wait Time (Base = 16 to 30 mins)	WAIT≤15	-0.036	0.014	2.5	-0.162	0.059	2.8
		WAIT>30	-0.023	0.037	0.6	-0.104	0.168	0.6
		CONSTANT	0.688	0.014	49.1	0.776	0.057	13.7
13	Wait Time (mins)	WAIT_TIME	0.003	0.000	6.8	0.012	0.002	5.9
		CONSTANT	0.640	0.004	172.9	0.574	0.017	34.6
14	Full Model	OFFPK	0.025	0.008	3.1	0.112	0.030	3.8
		ENT/HOL	0.042	0.011	3.8	0.199	0.058	3.4
		RETIRED	0.055	0.014	3.9	0.264	0.077	3.4
		HSEPERS	0.053	0.023	2.3	0.253	0.128	2.0
		CAR&PARK	-0.027	0.009	3.1	-0.118	0.038	3.1
		HUB	0.124	0.008	15.5	0.575	0.039	14.7
		LOCAL	-0.029	0.008	3.6	-0.121	0.036	3.4
		UPG10Y	0.071	0.009	7.9	0.317	0.039	8.1
		UPG≤5Y	0.033	0.010	3.3	0.161	0.045	3.6
		CONSTANT	0.561	0.008	73.8	0.252	0.035	7.2

Models fitted on 4,778 observations

6.28 Before and after analysis of the upgrading of Wellington stations

The preceding analysis used data at one point in time effectively presenting a 'snapshot picture' of bus stop and rail station quality in the three major cities of New Zealand in 2012/13.

This section presents a 'comparative static' analysis of the change in the rating of Wellington stations.

The analysis utilises data from two very similar rating surveys of Wellington train stations undertaken in 2002 and 2004 (Douglas Economics 2005). The surveys, which are described in the literature review (published separately as part 2 of this report), were undertaken partly to assess customer reaction to a replacement station at Petone. Other than this, there were no other significant upgrades or renovations between the 2002 and 2004 surveys. Thus in order to simplify the analysis, the 2002 and 2004 surveys were combined for all stations except Petone. The average rating was then compared with the 2012/2013 survey. For Petone, two comparisons were made: 2002 with 2012 (PET1) and 2004 with 2012 (PET2).

To assist in analysing the data, refurbishment works were classified into major (MAJ) and minor (min) works based on information provided by Ross Hayward (who managed the Tranz Metro Passenger Network until his retirement) and GWRC.

Table 6.48 lists the refurbishment works by station which included shelter, seating, platform surface, overbridges and subways (ease of platform on/off), lighting, general station renovation work, toilets, retail facilities and the car park. On the right of the table, an assessment is made as to whether the work constituted a 'major' or minor upgrade. Also tabulated is how old the refurbishment was (measured to November 2012). On the right of the table is the change in rating.

Ten stations were considered to have had a major upgrade, usually because the station buildings were rebuilt. The 10 upgrades are described below:

Petone station was identified as in need of an upgrade in the early 2000s. The old station building was demolished and a new station constructed and opened in March 2004. The works included a new bus access bay with a shelter, an upgraded platform canopy and shelter screens at the southern end of the veranda, platform seating and ground lighting for a restored historic flagpole. In 2009, improvements to the Dowse to Petone section of SH2 involved changes to the station car park access. The car park was extended south and a vehicle overbridge was built for car parkers and the pedestrian overbridge linking the station to the western side of SH2 was upgraded. The two platforms were upgraded with new frontages and lighting in preparation for the introduction of the new Matangi rolling stock. The change in passenger rating of the station between 2002 and 2013 was 29% points. The additional improvements, such as bicycle racks made in 2010 increased the rating by 8%.

The Petone station building was demolished (TB) and replaced with a new building which opened in March 2004. (ND) The change in passenger rating of the station (2002-2013) was 29% points. Further improvements such as bicycle racks were made in 2010 (ND) which increased the rating by 8%.

Epuni station building was removed in 2009 due to the possible presence of asbestos and replaced with three glass shelters. Lighting was also improved at the station.

Naenae station was rebuilt in 2012 with a new platform shelter, resurfaced platform and renovated subway connecting the platform to Cambridge and Oxford Terraces. The change in passenger rating was substantial, with an increase of 44% points in the overall rating (2003–2013).

A major upgrade of Naenae station was undertaken in 2012 with the platform surface renewed and the shelter replaced (SB). The change in passenger rating was substantial, with an increase of 44% points in the overall rating (2003–2013).

Plimmerton station was closed to the public between 1989 and 2010. Porirua City Council sought to repair the station rather than replace it with shelters. In 2009/2010 the building was restored and Mack's Track, a model railway retailer leased the building providing a ticket agency, café and destination store as well overseeing the public waiting room and other facilities. The design, refurbishment and funding was carried out by Tranz Metro Wellington with no financial assistance from any council with the cost relatively minor at around $160,000.[57] The restoration project was awarded a Rail Heritage Trust of New Zealand Restoration Award in 2011 as 'a model for other station restorations throughout the country' (Community action recognised, *Northern Courier*, 22 August 2011). The change in ratings was 22% points.

Paraparaumu was upgraded in 2010/11 at a cost of $1 million as part of the electrification to Waikanae. A new side platform was constructed on the new main line and a pedestrian underpass was built to connect the two platforms, replacing an earlier overbridge that connected the platforms to a car park. The change in rating was 14% points.

Waikanae station was rebuilt costing $1 million in 2010/11. The platform was rebuilt and resurfaced with new shelters and seating installed and a new car park. The change in rating was 35% points.

Solway, Matarawa, Renall St and Masterton were substantially renovated and/or rebuilt as part of upgrading all the stations on the Wairarapa line for new rolling stock. The upgrade involved rebuilding the platforms, new ramp access, lighting, electronic information displays and improvements to the car parks. The change in Solway's rating was 18% points. Similar work was done at Featherston, Woodside and Carterton but the works were judged to be more renovation than major upgrading.

[57] It would be useful to look at the increase in rating per dollar of expenditure.

Solway like Renall Street and Matarawa was upgraded in 2007 in part to prepare stations for new SW-class passenger carriages. The change in Solway's rating was 18% points. Photo on left Wikipedia and right ND.

Renovations and upgrades of a less substantial nature were also undertaken as listed in table 6.48.

Table 6.48 Improvements to Wellington stations 2002 – Dec 2012

Station	Shelt-er	Seat-ing	Plat surf	Plat on/off	Light-ing	Renov-ation	Toilet	Retail	Car park	Major upgrade	Upgrade years	Overall rating Δ
PET1	MAJ	min	-	-	MAJ	MAJ	-	MAJ	MAJ	MAJ	9	29%
PET2	-	min	MAJ	-	MAJ	-	MAJ	-	MAJ	-	-	8%
WEL	min	-	MAJ	-	-	-	MAJ	-	-	-	-	6%
WES	MAJ	-	MAJ	-	-	-	-	-	-	-	-	12%
MEL	-	-	-	-	-	MAJ	-	MAJ	-	-	-	13%
AVA	-	-	-	-	MAJ	-	-	-	-	-	-	-13%
WOB	-	-	-	min	MAJ	-	-	-	-	-	-	-2%
WAT	-	-	-	-	-	-	MAJ	-	MAJ	-	-	4%
EPU	MAJ	MAJ	MAJ	-	MAJ	MAJ	-	-	-	MAJ	5	29%
NAE	MAJ	MAJ	MAJ	min	MAJ	MAJ	-	-	min	MAJ	1	44%
WIN	-	-	-	-	-	-	-	-	-	-	-	-1%
TAI	MAJ	-	-	-	-	-	-	-	-	-	-	-2%
POM	-	-	-	-	-	-	-	-	MAJ	-	-	9%
SIL	-	-	-	-	-	-	-	-	-	-	-	5%
HER	-	min	-	-	MAJ	-	-	-	-	-	-	-11%
TRE	-	-	-	-	min	MAJ	-	-	MAJ	-	-	6%
WAL	-	-	-	-	-	-	-	-	-	-	-	1%
UPP	-	-	-	-	-	-	-	-	-	-	-	-4%
FEA	-	-	MAJ	-	MAJ	MAJ	MAJ	-	-	-	-	10%
WOO	-	-	MAJ	-	MAJ	MAJ	MAJ	-	min	-	-	19%
MAT	-	-	MAJ	min	MAJ	MAJ	-	-	-	MAJ	7	4%
CAR	-	MAJ	MAJ	-	MAJ	-	MAJ	-	min	-	-	8%
SOL	MAJ	MAJ	MAJ	min	MAJ	MAJ	-	-	min	MAJ	7	18%
REN	MAJ	MAJ	MAJ	-	MAJ	MAJ	-	-	-	MAJ	7	-5%
MAS	-	MAJ	MAJ	-	MAJ	-	MAJ	-	-	MAJ	7	10%
TAK	-	-	-	-	MAJ	MAJ	-	-	-	-	-	1%

Station	Shelt-er	Seat-ing	Plat surf	Plat on/off	Light-ing	Renov-ation	Toilet	Retail	Car park	Major upgrade	Upgrade years	Overall rating Δ
RED	-	-	MAJ	-	-	MAJ	-	-	MAJ	-	-	14%
TAW	-	-	-	-	-	-	-	-	-	-	-	-6%
LIN	-	-	-	-	-	-	-	-	-	-	-	-2%
KEN	-	-	MAJ	-	-	-	-	-	-	-	-	-12%
POR	-	MAJ	MAJ	-	MAJ	MAJ	MAJ	-	MAJ	-	-	5%
PAM	-	-	-	-	-	-	-	-	-	-	-	9%
MAA	-	-	-	-	-	-	-	-	-	-	-	-5%
PLI	MAJ	MAJ	-	MAJ	-	MAJ	-	MAJ	-	MAJ	2	20%
PUK	-	-	MAJ	-	MAJ	MAJ	-	-	-	-	-	9%
PAE	-	-	-	-	-	-	-	-	-	-	-	11%
PAP	MAJ	MAJ	MAJ	MAJ	MAJ	MAJ	MAJ	-	MAJ	MAJ	2	14%
WAI	MAJ	MAJ	MAJ	MAJ	MAJ	MAJ	MAJ	-	MAJ	MAJ	2	35%
CRO	-	MAJ	MAJ	-	MAJ	-	-	-	-	-	-	9%
NGO	-	MAJ	MAJ	-	MAJ	-	-	-	-	-	-	10%
AWA	-	MAJ	MAJ	-	MAJ	-	-	-	-	-	-	2%
SIM	-	MAJ	MAJ	-	MAJ	-	-	-	-	-	-	1%
BOX	-	MAJ	MAJ	-	MAJ	-	-	-	-	-	-	5%
KHA	-	MAJ	MAJ	-	MAJ	-	-	-	-	-	-	16%
RAR	-	MAJ	MAJ	-	MAJ	-	-	-	-	-	-	5%
JOH	-	MAJ	MAJ	-	MAJ	-	-	-	-	-	-	8%

Source: GWRC, Ross Hayward, Douglas Economics

To illustrate the scope of works, Steve Bird of GWRC provided some before and after photographs.

An example of renovation is the repainting of the shelter at Takapu Road. On the right is an example of improved lighting with the rectangular light replaced by strip lighting at Pomare (SB). This improvement was undertaken after the 2013 survey was completed. Takapu Rd's weather protection rating increased by 8% points 2003-2013 and the cleanliness and graffiti rating increased 9% but there was little change in the overall rating.

Undertaken just after the passenger survey was completed, the shelter at Mana leaked and the roof was replaced. Mana's weather protection rating reduced by 4% points 2003–2013 while the cleanliness and graffiti rating decreased by 21% 2003–2013. Also undertaken after the survey was completed, the old wooden seats at Woburn were replaced with new steel seats (SB). The seat rating had remained largely unchanged as did the overall rating between 2003 and 2013.

The analysis approach was effectively a set of paired 't' tests of the mean change in rating ($\Delta R\%$). The dependent variable was the difference in the attribute rating in 2013 minus 2003 ($R\%_{13} - R\%_{03}$).[58]

Appendix K (see part 3 of this report) tabulates the before and after ratings.

The explanatory variables were specified as dummy variables (0,1) that matched the data in table 6.48. This excluded the 'age since upgrade' variable (UPG_YEARS), which was the number of years between the upgrade and Jan 2013.

$$\Delta R\% = \beta o + \sum \beta i X i \qquad \text{(Equation 6.2)}$$

A logit formulation was also estimated (to keep predicted ratings within the 0,1 interval) see equation 6.3.

$$\Delta R\% = \ln\left[\frac{R\%_{13}}{1-R\%_{13}}\right] - \ln\left[\frac{R\%_{03}}{1-R\%_{03}}\right] \qquad \text{(Equation 6.3)}$$

A simple way to forecast the effect of an upgrade is to use the incremental formulation of the logit model shown in equation 6.4. The incremental model pivots on the existing rating. In the incremental formulation, the constant would normally be omitted unless a continuation of past trends is expected. It should be noted that the trend is measured over 10 years rather than a single year and so allowance for this should be made in the forecast (eg by dividing by 10 or using a compound growth factor).

$$R\%^{pred} = \frac{R\% \exp\{\sum \beta i X i\}}{R\% \exp(\sum \beta i X i + (1 - R\%)} \qquad \text{(Equation 6.4)}$$

A third model was fitted which was the ratio of the two ratings. The logarithm of the ratio was taken so that the model estimated constant 'elasticities'. To derive the elasticities, the exponent of the beta parameters needs to be taken.

$$\ln\left(\frac{R\%_{13}}{R\%_{03}}\right) = \beta o + \sum \beta i X i \qquad \text{(Equation 6.5)}$$

The observations were weighted in accordance with their sampling accuracy. Only observations with at least six responses in both years were included.

[58] 2013 and 2003 are approximate 'dates' and are used for ease of understanding.

Accuracy was measured using the denominator of a standard paired 't' test (with varying sample sizes and standard deviations) for each year, equation 6.6.

$$STE_i = \sqrt{\frac{StDev_{i(13)}}{n_{i(13)}} + \frac{StDev_{i(03)}}{n_{i(03)}}}$$ (Equation 6.6)

The weight was the inverse of the standard error ($1/STE_i$) and to maintain the degrees of freedom, the weights were standardised by calculating the proportion of the total reciprocal STE and multiplying by the number of station 'observations' (N) which was 46 for the overall rating and 45 for the individual attributes.[59]

$$Weight_i = N\frac{\sum STE_i}{STE_i}$$ (Equation 6.7)

In this way, observations with bigger sample sizes and/or less variation in the constituent ratings were given more weight. Thus in the weather protection rating model, Wellington train station with 746 observations for 2003 and 399 for 2013 had a weight of 3, whereas Woburn with 138 and 33 respondents respectively had a weight of 1 and Heretaunga with 21 and 17 respondents had a weight of 0.6. Appendix K, table K.3 (see part 3 of this report) presents the standard errors.

Table 6.49 presents the change in the ratings for each attribute. At the bottom, two average measures are provided. The measure labelled AvS is the change in the average rating of the stations unweighted by passenger use (survey returns). The measure labelled AvSR is the average rating after weighting by passenger use (survey returns).

[59] Matarawa station had enough observations for the overall rating but not enough for the individual attributes.

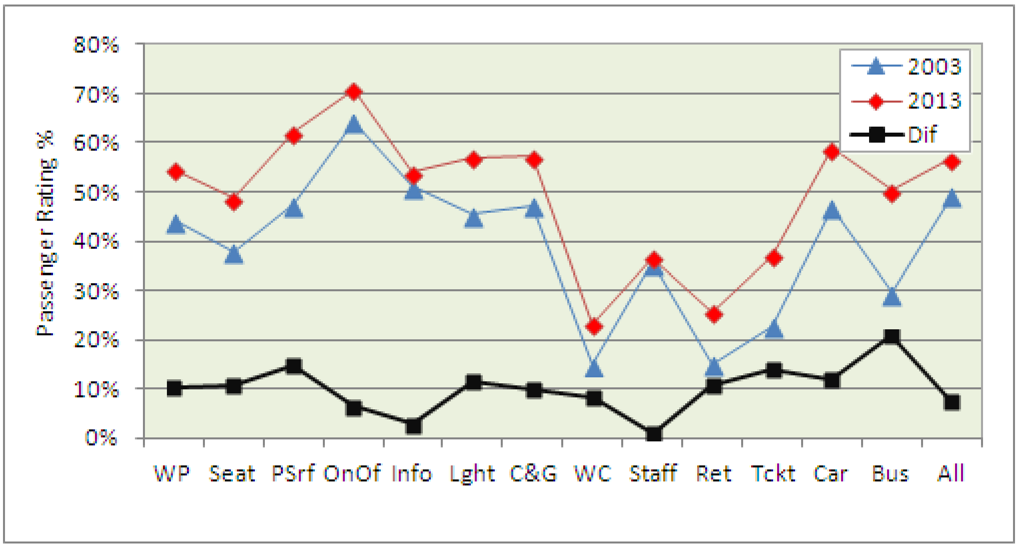
Table 6.49 Change in attribute ratings for Wellington stations (2003–2013)

Stat	Wthr Prot	Seat-ing	Plat Surf	OnOff	Info	Light-ing	Clean Graf	Toil-ets	Staff	Retail	Ticket	Car Park	Bus Stop	All
PET1	21%	25%	28%	9%	20%	28%	26%	34%	5%	39%	14%	19%	24%	29%
PET2	6%	3%	11%	1%	0%	14%	-1%	8%	-5%	14%	5%	14%	17%	8%
WEL	8%	7%	14%	-2%	2%	8%	16%	24%	7%	21%	10%	16%	10%	6%
WES	14%	21%	27%	-7%	6%	18%	24%	20%	8%	7%	2%	4%	26%	12%
MEL	15%	19%	9%	3%	5%	18%	21%	14%	19%	57%	61%	8%	20%	13%
AVA	-2%	-13%	-16%	-13%	-18%	-16%	-19%	-15%	-5%	-8%	4%	-9%	14%	-13%
WOB	1%	-1%	2%	-18%	-2%	9%	0%	-4%	-3%	-7%	3%	1%	13%	-2%
WAT	9%	8%	10%	1%	0%	1%	6%	11%	9%	9%	5%	11%	16%	4%
EPU	29%	39%	35%	10%	20%	31%	36%	17%	2%	23%	23%	18%	32%	29%
NAE	24%	44%	46%	20%	29%	29%	52%	21%	14%	3%	17%	35%	33%	44%
WIN	0%	1%	4%	-7%	4%	12%	-11%	5%	9%	5%	18%	21%	26%	-1%
TAI	1%	-6%	1%	-16%	3%	7%	-4%	0%	-10%	-2%	3%	1%	5%	-2%
POM	10%	11%	6%	26%	9%	8%	-6%	25%	4%	9%	11%	25%	28%	9%
SIL	15%	12%	14%	2%	8%	16%	10%	-2%	0%	1%	20%	9%	21%	5%
HER	-15%	-11%	-12%	-22%	-7%	-6%	-4%	-13%	-26%	-11%	-11%	-28%	-5%	-11%
TRE	0%	5%	8%	17%	-6%	10%	10%	0%	-7%	10%	11%	1%	10%	6%
WAL	2%	4%	2%	2%	0%	7%	9%	2%	-1%	8%	16%	1%	11%	1%
UPP	5%	-1%	4%	2%	-4%	5%	3%	-4%	-1%	-1%	6%	10%	19%	-4%
FEA	15%	13%	11%	13%	-6%	8%	6%	13%	-2%	17%	4%	15%	27%	10%
WOO	18%	19%	44%	34%	14%	30%	34%	21%	7%	3%	9%	31%	28%	19%
MAT	na	na	na	na	na	na	na	na	na	na	na	na	na	4%
CAR	27%	22%	40%	40%	7%	7%	23%	28%	11%	24%	10%	25%	44%	8%
SOL	39%	28%	37%	50%	41%	29%	42%	-5%	-17%	-3%	20%	32%	17%	18%
REN	6%	14%	20%	46%	3%	9%	38%	0%	8%	-4%	27%	8%	16%	-5%
MAS	16%	17%	14%	13%	8%	9%	11%	8%	9%	25%	17%	20%	40%	10%
TAK	8%	9%	9%	-14%	-7%	11%	9%	3%	3%	-1%	16%	8%	24%	1%
RED	14%	14%	32%	33%	6%	19%	18%	1%	15%	5%	22%	10%	24%	14%
TAW	4%	3%	8%	-13%	-7%	0%	-5%	8%	4%	11%	22%	-4%	20%	-6%
LIN	14%	15%	0%	-1%	-4%	5%	-7%	0%	-8%	-2%	8%	-1%	10%	-2%
KEN	7%	-14%	8%	-15%	30%	-10%	-38%	-23%	-48%	-13%	18%	1%	4%	-12%
POR	5%	3%	9%	-1%	1%	5%	2%	4%	5%	16%	6%	7%	14%	5%
PAM	5%	9%	10%	-7%	-4%	5%	5%	19%	15%	30%	32%	6%	18%	9%
MAA	-4%	3%	-20%	-6%	-20%	1%	-21%	-2%	-4%	4%	13%	27%	29%	-5%
PLI	16%	13%	13%	6%	-5%	17%	22%	37%	28%	56%	58%	24%	22%	20%
PUK	10%	17%	30%	23%	3%	15%	-5%	4%	-2%	3%	12%	8%	-7%	9%
PAE	14%	0%	7%	-3%	-3%	12%	17%	-1%	2%	15%	10%	8%	28%	11%
PAP	21%	13%	16%	-1%	6%	16%	13%	29%	3%	32%	9%	15%	19%	14%
WAI	43%	41%	30%	37%	40%	35%	35%	48%	12%	42%	24%	28%	56%	35%
CRO	-5%	-2%	18%	38%	-2%	12%	12%	8%	6%	6%	16%	16%	20%	9%
NGO	11%	16%	17%	1%	-12%	11%	9%	11%	1%	8%	22%	18%	35%	10%
AWA	5%	5%	14%	1%	-12%	9%	12%	8%	-2%	1%	4%	9%	22%	2%
SIM	7%	4%	15%	10%	-1%	14%	-2%	-6%	-15%	-8%	-2%	10%	26%	1%
BOX	9%	15%	32%	1%	-5%	19%	14%	-1%	-13%	-3%	3%	19%	26%	5%
KHA	11%	22%	23%	4%	-4%	21%	30%	7%	9%	18%	15%	22%	23%	16%
RAR	-1%	2%	16%	0%	-5%	5%	2%	2%	-4%	2%	12%	13%	16%	5%
JOH	8%	11%	13%	-5%	-4%	6%	5%	4%	5%	19%	9%	9%	17%	8%
AvS	10%	11%	15%	6%	3%	12%	10%	8%	1%	11%	14%	12%	21%	8%
AvSR	11%	11%	14%	5%	3%	11%	11%	13%	5%	18%	14%	12%	20%	10%

Figure 6.42 presents the average station rating measured (AvS) for 2003 and 2013 and also the difference in rating (2003–2013). The rating profile was similar in both 'years' with higher ratings for ease of on/off and platform surface; medium ratings for platform surface lighting, cleanliness and graffiti, car parking and bus transfer; a slight lower rating for seating and low ratings for toilets, staff, retail and ticketing.

The 2013 ratings were higher for all attributes than in 2003. In 2003, the overall rating was 49% and in 2013 it was 57%, an increase of 8% points. Across the attributes, the biggest increase was in the ease of bus transfer which increased 21% points from 29% to 50%. Ticketing, retail, car parking, lighting, platform surface, seating and cleanliness and graffiti increased by 10% to 15%. Attributes where there was little increase were information (1%) and staff (3%).

Figure 6.42 Change in attribute ratings for Wellington stations (2003–2013)



The increase was not uniform as the set of graphs in figures 6.43a–n show. A total of 14 graphs are presented with each graph showing the mean difference and also high and low estimates based on the standard error. The last graph presents the overall station rating.

The mean change in rating is shown plus one standard error above and one standard error below. The standard error range indicates the sampling error associated with the mean estimate.

Figure 6.43a Change in attribute rating for Wellington stations 2003–2013

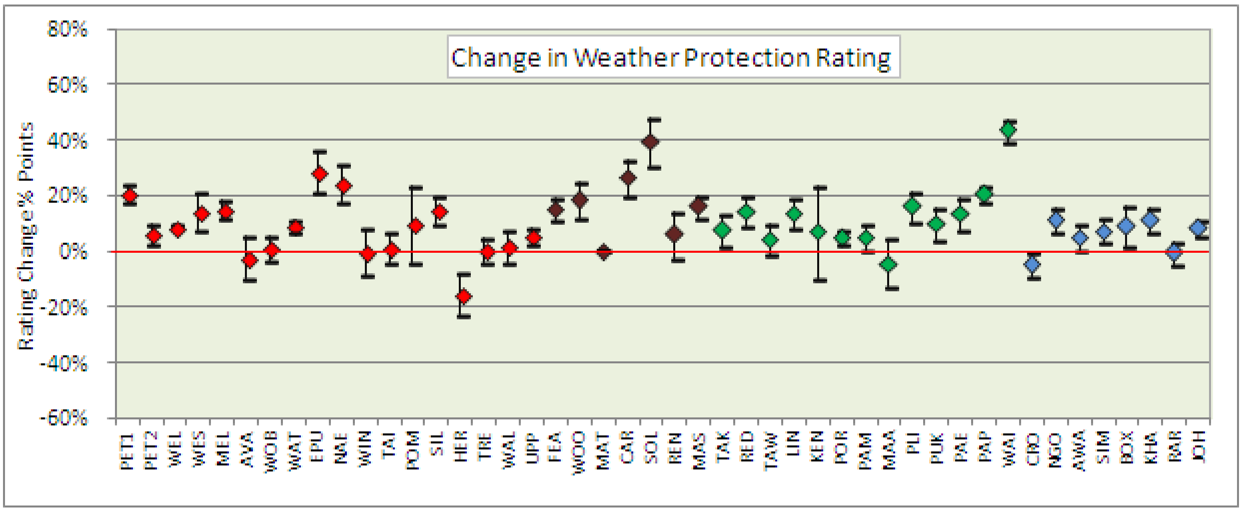


Figure 6.43b Change in attribute rating for Wellington stations 2003–2013

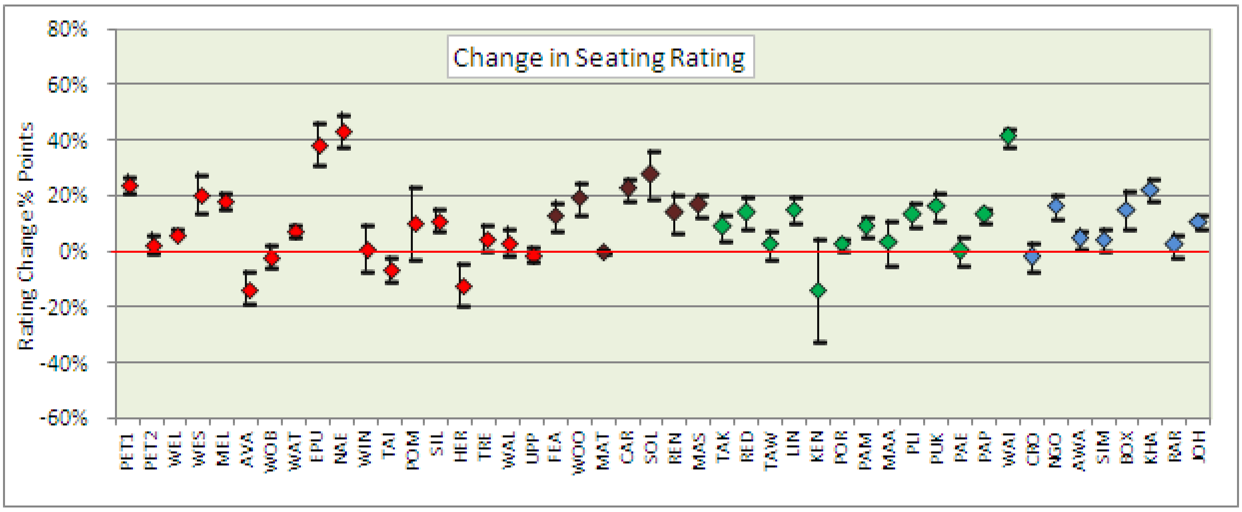


Figure 6.43c Change in attribute rating for Wellington stations 2003–2013

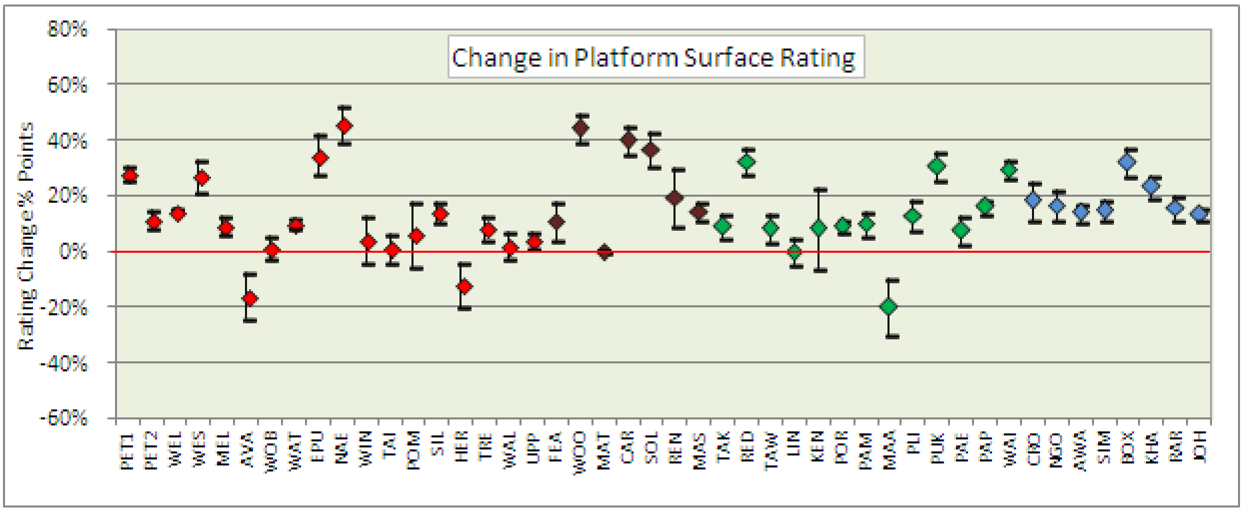


Figure 6.43d Change in attribute rating for Wellington stations 2003–2013

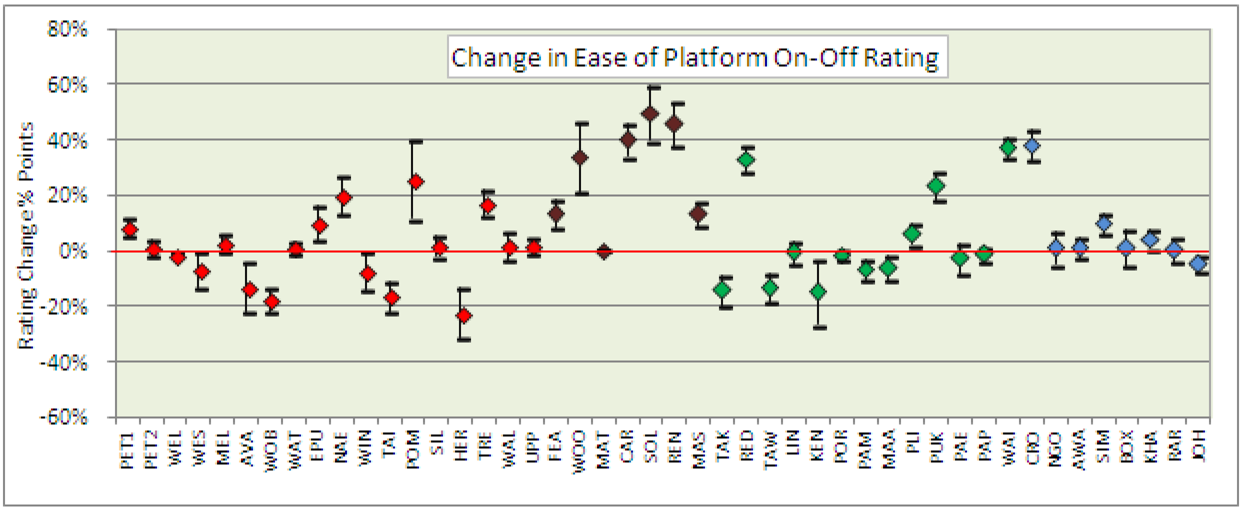


Figure 6.43e Change in attribute rating for Wellington stations 2003–2013

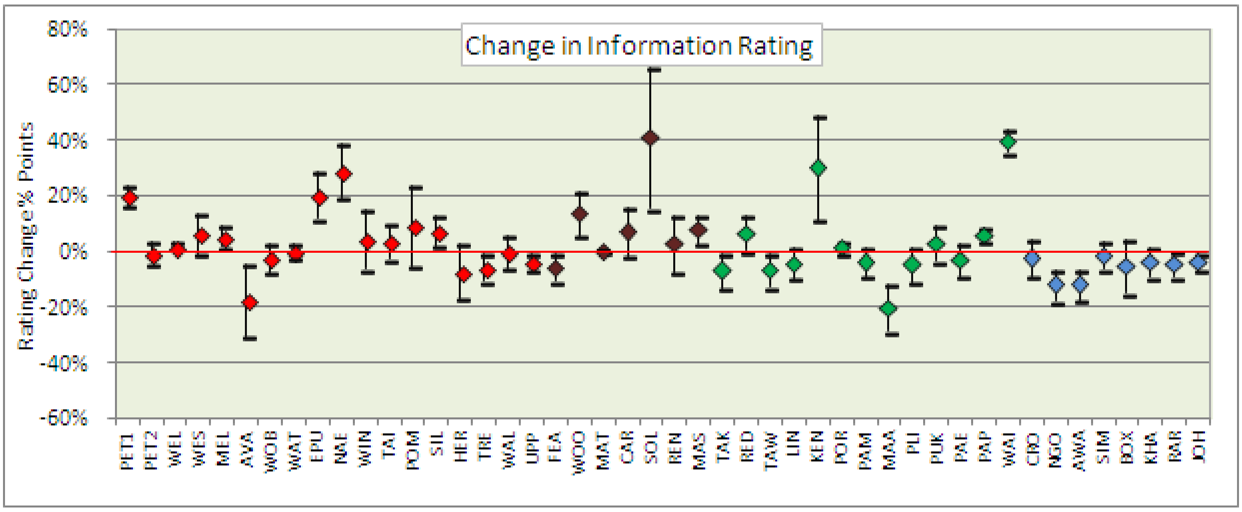


Figure 6.43f Change in attribute rating for Wellington stations 2003–2013

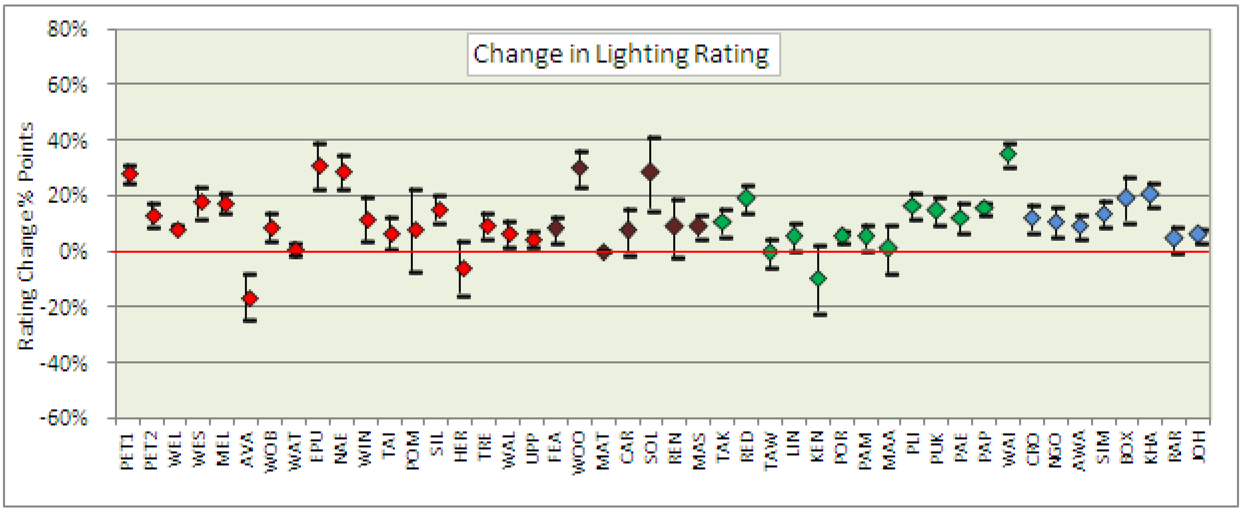


Figure 6.43g Change in attribute rating for Wellington stations 2003–2013

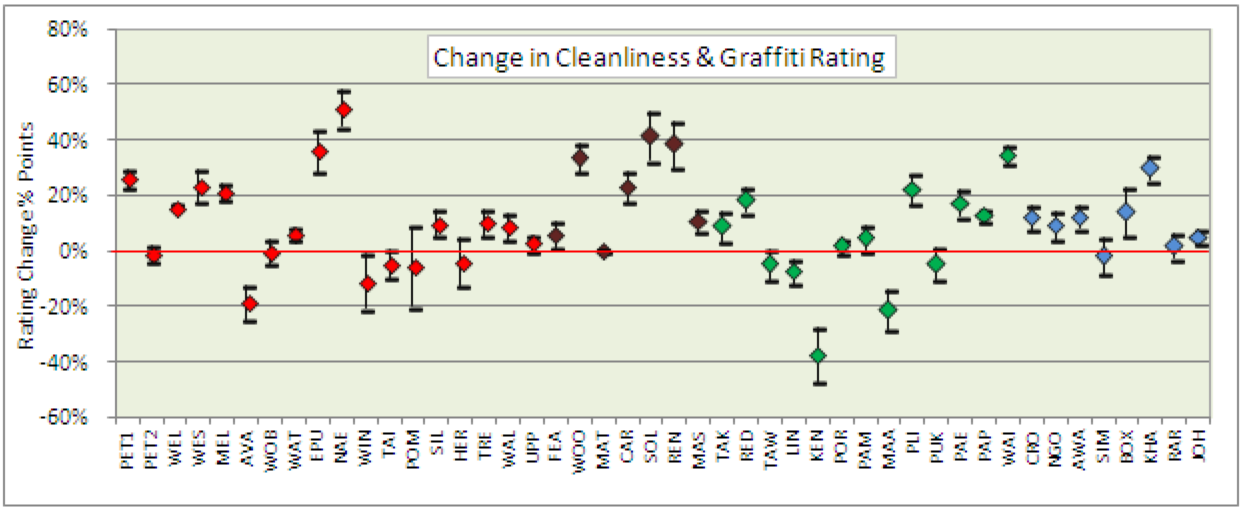


Figure 6.43h Change in attribute rating for Wellington stations 2003–2013

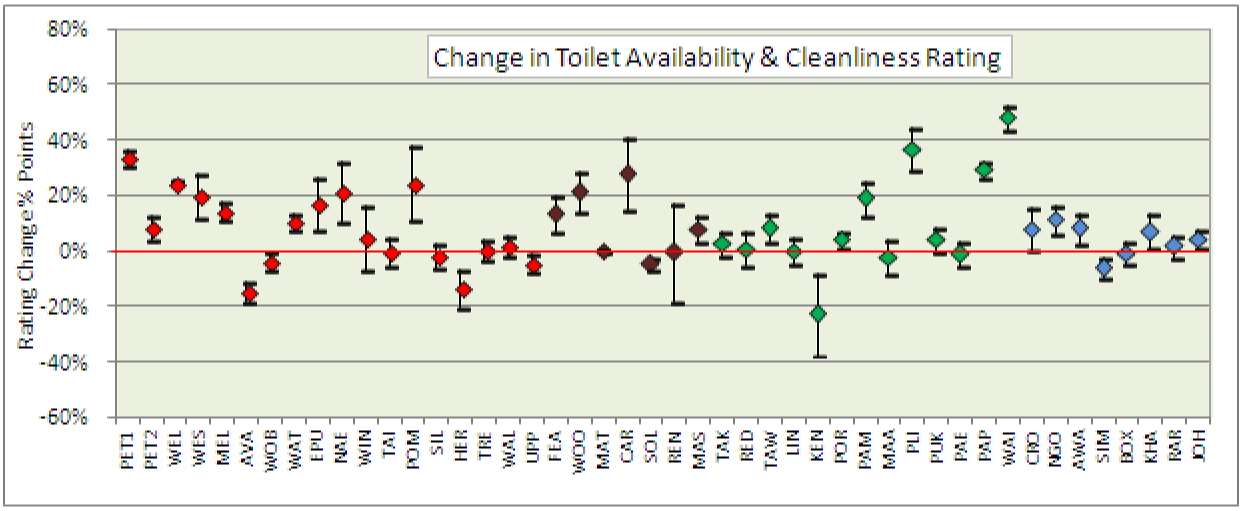


Figure 6.43i Change in attribute rating for Wellington stations 2003–2013

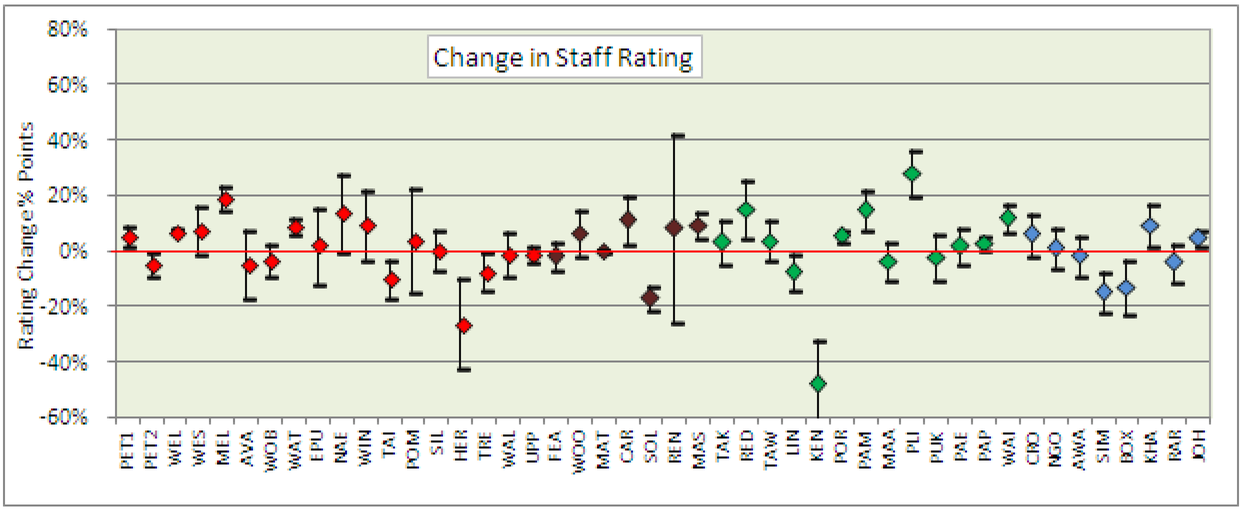


Figure 6.43j Change in attribute rating for Wellington stations 2003–2013

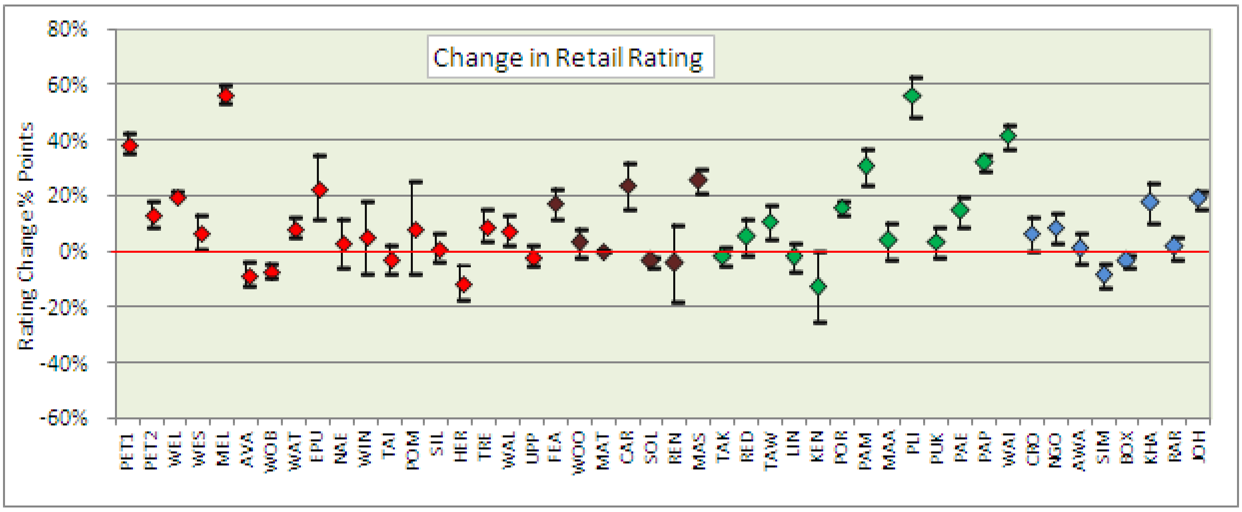


Figure 6.43k Change in attribute rating for Wellington stations 2003–2013

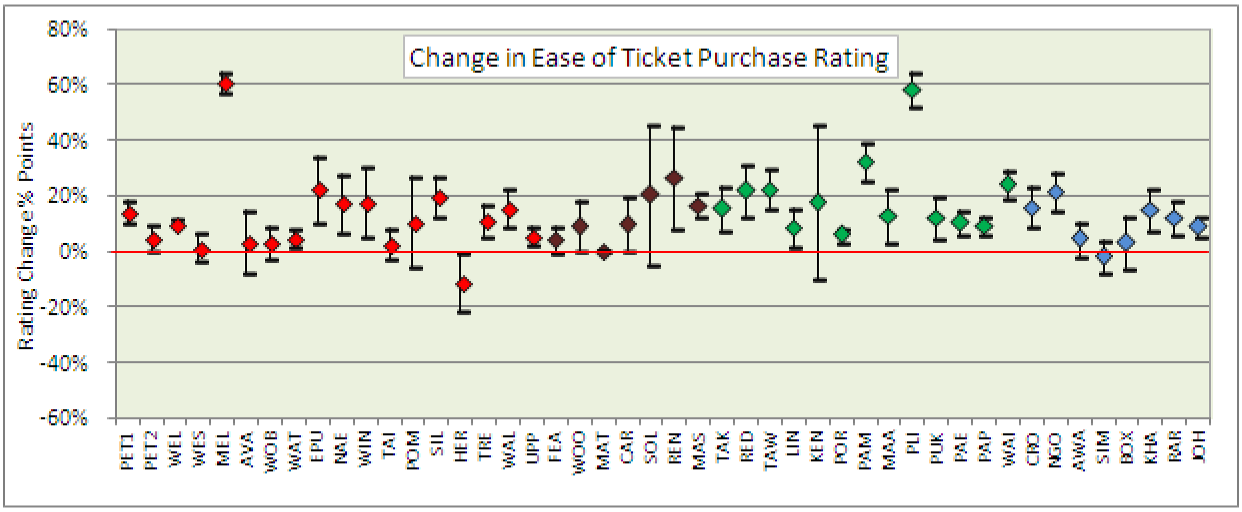


Figure 6.43l Change in attribute rating for Wellington stations 2003–2013

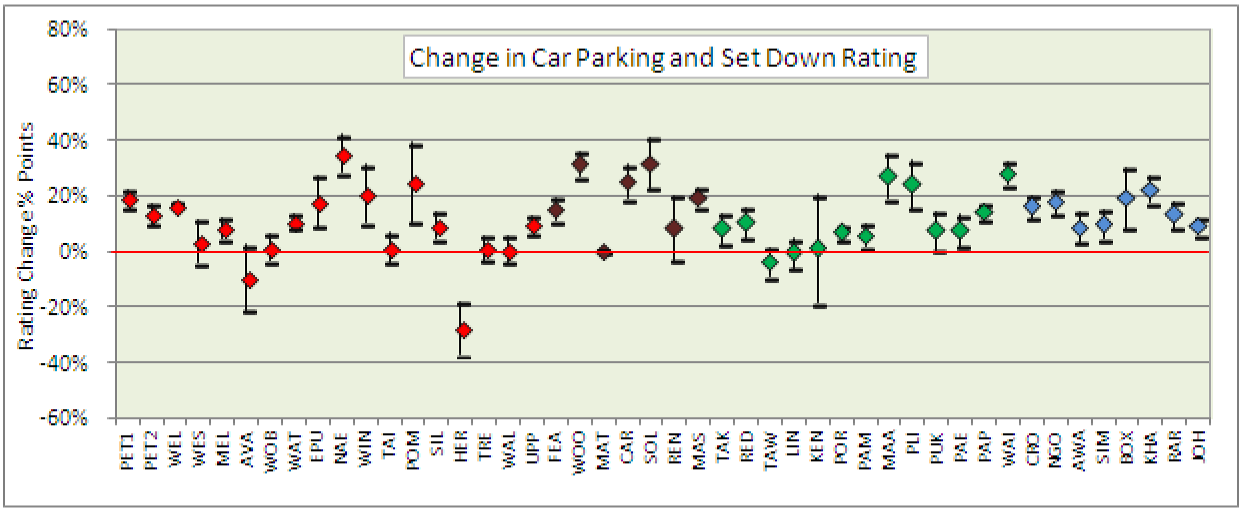


Figure 6.43m Change in attribute rating for Wellington stations 2003–2013

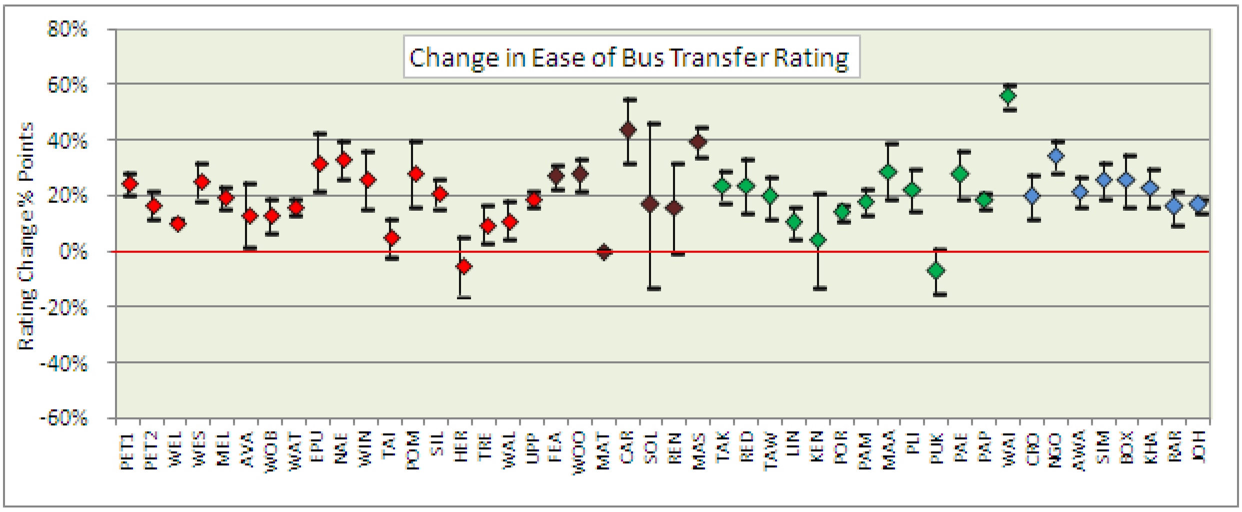
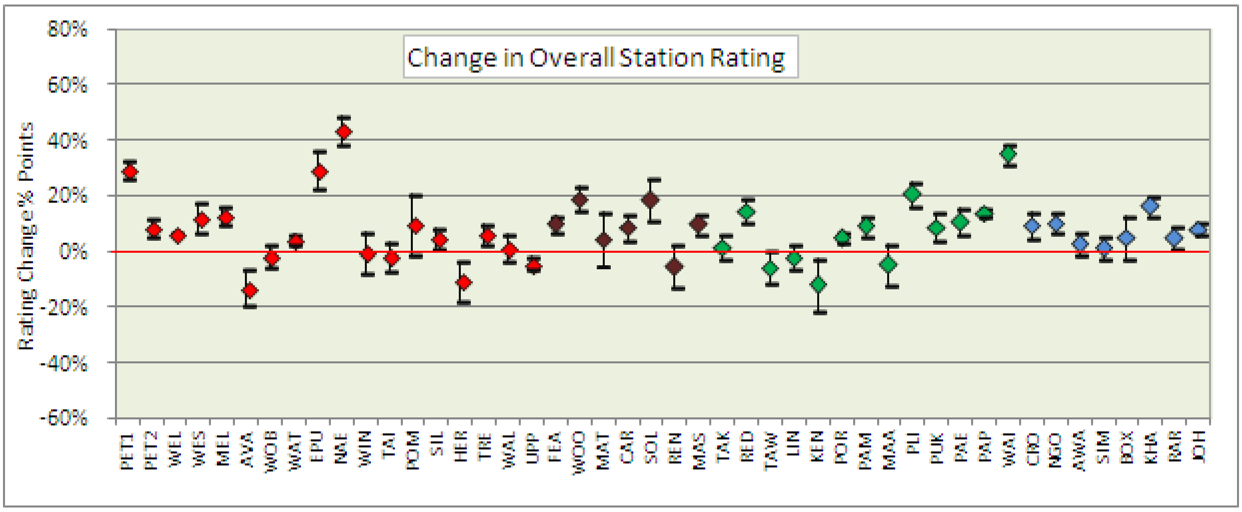


Figure 6.43n Change in attribute rating for Wellington stations 2003–2013



The fitted models, three for each attribute are presented in table 6.50.

Stepwise regression was used to determine the significant explanatory variables. All the variable parameters were of the expected sign. Upgrading or renovation had a positive effect on the ratings. The length of time since upgrading (UPG_YEARS) dampened the rating effect but was only significant in the overall rating model (#14). The explanatory power was reasonable for the overall model, with half the variation in the rating change across stations explained. However for the models of staff and toilets, the added explanation provided by the upgrade variables was low.

Table 6.50 Explanatory models of station attribute rating change

#	Attribute	Variable	Linear β	Linear STE	Linear |t|	Linear Adj R^2	Logit β	Logit STE	Logit |t|	Logit Adj R^2	Log Ratio β	Log Ratio STE	Log Ratio |t|	Log Ratio e(β)	Log Ratio Adj R^2
1	Weather Protection	UPGRADE	0.137	0.033	4.2		0.614	0.150	4.1		0.267	0.100	2.7	1.31	
		RENOVATION	0.044	0.027	1.6	0.43	0.190	0.124	1.5	0.43	0.169	0.080	2.1	1.18	0.34
		CONSTANT	0.062	0.014	4.4		0.260	0.064	4.1		0.108	0.020	5.4	1.11	
2	Seating	UPGRADE	0.142	0.044	3.2		0.614	0.200	3.1		0.318	0.126	2.5	1.37	
		RENOVATION	0.075	0.037	2.0	0.40	0.348	0.167	2.1	0.39	0.240	0.105	2.3	1.27	0.35
		CONSTANT	0.052	0.007	7.4		0.213	0.032	6.7		0.113	0.020	5.7	1.12	
3	Platform Surface	PLTSURF RENEW	0.165	0.030	5.5		0.725	0.136	5.3		0.300	0.065	4.6	1.35	
		RENOVATION	0.104	0.030	3.5	0.51	0.479	0.141	3.4	0.52	0.190	0.067	2.8	1.21	0.43
		CONSTANT	0.019	0.020	1.0		0.066	0.090	0.7		0.027	0.043	0.6	1.03	
4	Platform on/off	PLTSURF RENEW	0.136	0.044	3.1		0.627	0.212	3.0		0.234	0.078	3.0	1.26	
		RENOVATION	0.147	0.046	3.2	0.37	0.718	0.204	3.5	0.35	0.236	0.081	2.9	1.27	0.31
		CONSTANT	-0.063	0.021	3.0		-0.293	0.098	3.0		-0.010	0.052	0.2	0.99	
5	Infor-mation	UPGRADE	0.188	0.040	4.7	0.33	0.798	0.167	4.8	0.33	0.798	0.167	4.8	2.22	0.33
		CONSTANT	-0.009	0.018	0.5		-0.035	0.075	0.5		-0.035	0.075	0.5	0.97	
6	Lighting	UPGRADE	0.082	0.037	2.2		0.356	0.159	2.2		0.141	0.058	2.4	1.15	
		RENOVATION	0.082	0.031	2.6	0.36	0.341	0.132	2.6	0.36	0.136	0.071	1.9	1.15	0.29
		CONSTANT	0.070	0.013	5.4		0.284	0.053	5.4		0.140	0.030	4.7	1.15	
7	Clean & Grafitti	UPGRADE	0.185	0.061	3.0		0.852	0.267	3.2		0.266	0.097	2.7	1.30	
		RENOVATION	0.107	0.051	2.1	0.39	0.473	0.223	2.1	0.41	0.157	0.118	1.3	1.17	0.25
		CONSTANT	0.025	0.010	2.5		0.092	0.043	2.1		0.072	0.050	1.4	1.07	
8	Toilets	UPGRADE	0.143	0.044	3.3		ns	ns	ns		0.600	0.380	1.6	1.82	
		TOILET UPGRADE	0.127	0.042	3.0	0.32	1.039	0.538	1.9	0.06	ns	ns	ns	ns	0.06
		CONSTANT	0.025	0.018	1.4		-0.185	0.279	0.7		0.160	0.960	0.2	1.17	
9	Staff	RETAIL UPG	0.046	0.017	2.7	0.14	0.271	0.218	1.2	0.01	0.213	0.156	1.4	1.24	0.04
		CONSTANT	0.013	0.014	0.9		-0.140	0.181	0.8		-0.157	0.121	1.3	0.85	
10	Retail	RETAIL UPG	0.429	0.072	6.0	0.39	2.402	0.943	2.5	0.11	1.493	0.615	2.4	4.45	0.10
		CONSTANT	0.078	0.019	4.1		0.212	0.244	0.9		0.245	0.159	1.5	1.28	
11	Ticketing	RETAIL UPG	0.326	0.060	5.4	0.26	1.639	0.455	3.6	0.21	1.076	0.360	3.0	2.93	0.16
		CONSTANT	0.119	0.016	7.4		0.777	0.135	5.8		0.547	0.110	5.0	1.73	
12	Car Parking	UPGRADE	0.100	0.040	2.5		0.409	0.183	2.2		0.194	0.108	1.8	1.21	
		CAR PARK UPG	0.079	0.035	2.3	0.24	0.343	0.162	2.1	0.21	0.100	0.095	1.1	1.11	0.12
		CONSTANT	0.078	0.015	5.2		0.349	0.067	5.2		0.167	0.051	3.3	1.18	
13	Bus Facilties	UPGRADE	0.101	0.040	2.5	0.11	0.452	0.209	2.2	0.08	0.213	0.164	1.3	1.24	0.04
		CONSTANT	0.188	0.018	10.4		0.918	0.094	9.8		0.572	0.073	7.8	1.77	
14	Overall Rating	UPGRADE	0.225	0.057	3.9		0.980	0.240	4.1		0.428	0.122	3.5	1.53	
		UPG_YEARS	-0.020	0.010	2.0	0.50	-0.088	0.043	2.0	0.48	-0.038	0.021	1.8	0.96	0.44
		CAR PARK UPG	0.086	0.029	3.0		0.374	0.121	3.1		0.159	0.061	2.6	1.17	
		CONSTANT	0.023	0.015	1.5		0.089	0.098	0.9		0.033	0.033	1.0	1.03	

Models 1-13 fitted on 44 and model 14 on 45 observations

The log ratio model (on the right of the table) predicts that station upgrading increases the rating by 1.53 times the base rating. Clearly for base ratings exceeding 65%, the predicted rating would exceed 100% thus care needs to be used in applying this model.

The logit formulation ensures that predictions above 1 cannot happen. Putting 65% into equation 6.8 gives a predicted rating from station upgrading on the first day of completion of 85% and a rating of 76% after five years.

$$R\%^{pred} = \frac{R\% \exp\{\sum \beta iXi\}}{R\% \exp(\sum \beta iXi + (1 - R\%)} = \quad \text{(Equation 6.8)}$$

$$\frac{0.65 \exp(0.988 - 0.088(UPG\_YEARS = 0)}{0.65 \exp(0.988 - 0.088(UPG\_YEARS = 0) + (1 - 0.65)} = 85\%$$

Given the higher goodness of fit statistics the logit model is preferred.

6.28.1 Weather protection

Upgrading increased the weather protection rating by 13% points. Renovation was significant at the 95% confidence level in the rating model and increased the rating by a factor of 1.17. For the difference and logit models, the renovation variable was significant at around the 90% confidence level. In the difference model, renovation increased the rating by 4.4%. Given that upgrade encompasses renovation (all the stations that were upgraded were considered to have been renovated), the two effects need to be added. By doing this, the effect of an upgrade increased to 18.1%.

The constant of 0.062 indicates that the weather protection rating had increased by around 6.2% over the 10-year period. However, the shelter upgrade variable did not add to the explanatory power of the model and was not included.

Across the stations, Solway and Waikanae ratings improved by around 40%. Solway's rating increased from 32% to 72% and Waikanae's from a low 14% to 57%. Carterton's rating increased by 36% although the works were considered as renovation rather than a major upgrade in the facilities provided.

Stations where the ratings declined were at Heretaunga (54% to 38%) and Mana (38% to 34%).

6.28.2 Seating

Seating was similar to weather protection. Upgrading and renovation were significant explanatory variables and there was a general upward underlying trend in the rating of 5% points.

Across the stations, the ratings of Waikanae, Epuni and Naenae increased by around 40% and whereas the ratings of Kenepuru, Ava and Heretaunga declined by around 15%.

6.28.3 Platform surface

The platform renewal variable was the most significant explanatory variable and predicted a 16.5% point increase in rating. Also significant was the station renovation variable which predicted a 10.4% increase.

In addition to Waikanae, Epuni and Naenae, the ratings of Redwood, Pukerua Bay and the Johnsonville line stations increased more than the average reflecting the platform work to accommodate the new Matangi trains. Ava, Heretaunga and Mana experienced declines in their platform rating.

6.28.4 Platform on/off

The rating of the ease of getting on and off the platform was similar to platform surface. Platform renewal and station renovation were significant explanatory variables although the relative size of the parameters changed with renovation increasing in importance and platform renewal decreasing.

6.28.5 Information

There was little movement in the rating of information over the 10-year period despite the introduction of electronic timetables.

The predicted trend over the 10 years was slightly negative which was reflected in a negative constant albeit of weak statistical significance. At stations where there had been a major upgrade, the information rating increased by 19% points.

Across the stations, Solway and Kenepuru experienced large increases but there was a wide survey error around the estimates. On the Johnsonville line, the information rating in 2013 was consistently down by around 5% points on 2003.

6.28.6 Lighting

Tranz Metro improved station lighting to meet architectural guidelines between 2004 and 2008. The ratings reflected this with a general increase of around 10% points. Ava, Heretaunga and Kenepuru were exceptions where declines in rating occurred. The estimated constant picked up a general improvement in ratings of 7%. Major upgrade and renovation were significant with both increasing the rating by 8%.

6.28.7 Cleanliness and graffiti

There was a wide spread in the rating change across the stations. There were noticeable declines at Kenepuru of 40% and at Mana and Ava of 20%. The photographs of Kenepuru and Ava illustrate the problems with graffiti that both these stations had experienced.

The model picked up the effect of upgrading and renovation on the cleanliness and graffiti rating. Upgrading increased the rating by 18.5% and renovation by 10.7%. The constant was statistically significant and indicated a small underlying improvement of 2.5%.

6.28.8 Toilet availability and cleanliness

The model picked up the effect through upgrading toilets and upgrading the station in general. On its own, upgrading toilets increased the rating by 13% points which was similar to upgrading the station in general. As many stations do not have toilets, the incremental model is recommended for assessing improvements to existing toilets.

6.28.9 Staff availability and helpfulness

The rating of staff was not related to station upgrading but it did increase with retail improvements reflecting the assistance that staff at privately run shops at stations such as at Melling, Plimmerton and Carterton can provide. The estimated effect was not large, however, at 6% points. The estimated constant was insignificant indicating that the staff rating had remained reasonably unchanged over the 10-year period.

6.28.10 Retail – the ability to buy food, drinks and newspapers

The opening of the cafe at Melling and the shop at Plimmerton station was noticed by passengers with the retail rating increasing by 56%. The model picked up the effect ‘system wide’ in the retail variable which had a large positive parameter indicating an increase of 43% in the rating.

6.28.11 Ticket purchase

Melling and Plimmerton also experienced large increases of 60% in the rating of ‘ease of ticket purchase’. Both stations had retailing/cafes introduced. The model estimated an uplift of around a third from the provision of retail facilities. The model constant at 0.119 indicated a general improvement of 12% in ticket provision between 2003 and 2013.

6.28.12 Car parking and car passenger pick-up and set-down facilities

The rating of station car parking and set down facilities was modelled to increase by 10% points from a major station upgrade. This was a little more than upgrading the car park itself which predicted an 8% increase.

There was a general upwards trend in the car park rating across the stations which can be seen from the graph. The model picked this up in the constant which estimated an 8% point system-wide improvement.

6.28.13 Bus transfer

The 'ease of transfer to and from bus' ratings increased generally across the network which was picked up by the constant that measured a 19% increase. Station upgrading added 10% to the increase. Across the stations, Waikanae was the stand-out performer with an increase of 56% points in response to the station rebuild.

6.28.14 Overall rating

For the overall rating model (#14), upgrading a station increased the rating by 22.5% points and upgrading a station car park by 8.5% points. Over time, the rating effect decreased at a rate of 2% points per year. Thus after 10 years, the model predicts that an upgrade would be nearly fully depreciated from a passenger perspective.

The last graph in figure 6.43n shows how station upgrading affected the overall passenger rating. The four stations where the biggest increase in rating occurred were Naenae, Epuni, Petone (2002–2013) and Waikanae and all four stations had major upgrades. Plimmerton and Solway which were also upgraded had high rating increases. The rating of Paraparaumu increased too but by only 15% reflecting the reasonably high base rating of 60%.

The only exception where a rating reduced after an 'upgrade' was at Renall Street where the rating declined despite the new platform and new shelter.

The constant was small at 0.023 indicating that there was little underlying change in passenger ratings over the 10 years.

6.29 Relative importance of train station stop attributes

The relative importance of the individual attributes in explaining the overall station rating was established using the same method as for bus stops and vehicles.

The analysis took advantage of the earlier 2002–2004 Wellington survey (Douglas Economics 2005) to increase the number of observations from 3,290 to 8,713. As with the bus stop and vehicle ratings, 'non-rating' responses were retained but treated as a zero rating. Implicitly therefore, anyone not rating an attribute was treated as considering the attribute as unimportant.

Linear and logistic models were fitted. Table 6.51 presents the estimated model. Also presented is the average rating, the percentage of respondents giving a rating and the adjusted rating (ie where non-ratings were treated as a zero rating).

The adjustments were mostly negligible with only toilet availability, staff, retail and ticket purchase affected noticeably.

The linear model explained 59% of the variation in the overall rating. The most important attribute was cleanliness and graffiti which effectively explained 17% of the overall rating. Weather protection and seating were the next most important explaining around 10% each. Thus the three most explanatory attributes were the same as for bus stops.

Slightly less important were platform surface, ease of getting to/from the platform and information. Ticket purchase and car parking were next. These five attributes explained 7% to 9% each of the overall rating. Station lighting was slightly less important at 6.5%.

Of less importance were the availability and helpfulness of staff, toilet availability and cleanliness, the ability to buy food and drink and the ease of bus transfer. Ease of bus transfer was only statistically significant when limited to passengers who accessed the station by bus (about 8% of the sample).

Table 6.51 Train station explanatory basic model

Variable	Rate %	Rating %	Adjusted rate %	Linear			Logit		
				β	STE	|t|	β	STE	|t|
Weather protection	99%	52%	51%	0.125	0.008	15.6	0.571	0.045	12.7
Platform seating	99%	45%	44%	0.103	0.009	12.0	0.517	0.048	10.8
Platform surface	98%	56%	55%	0.085	0.009	9.9	0.401	0.048	8.4
Ease of getting to/from platform	99%	70%	69%	0.091	0.008	11.4	0.422	0.045	9.4
Timetable info and announcements	97%	59%	58%	0.085	0.007	11.8	0.384	0.038	10.1
Station lighting	95%	57%	54%	0.065	0.008	8.2	0.302	0.044	6.9
Station cleanliness and graffiti	98%	56%	55%	0.173	0.008	21.6	0.78	0.045	17.3
Toilet availability and cleanliness	79%	34%	27%	0.012	0.006	1.9	0.101	0.034	3.0
Availability and helpfulness of staff	84%	55%	46%	0.023	0.006	3.7	0.101	0.032	3.2
Ability to buy food, drinks, paper	79%	39%	31%	0.040	0.007	6.1	0.201	0.033	6.1
Ease of ticket purchase	83%	53%	44%	0.077	0.006	12.1	0.35	0.033	10.6
Car parking and car pick up	92%	57%	52%	0.070	0.006	11.8	0.349	0.030	11.8
Ease of bus transfer * bus users[a]	97%	66%	64%	0.021	0.008	2.5	0.128	0.047	2.7
Constant (α)	na	na	na	0.084	0.006	15.0	-1.949	0.035	55.7
Overall rating				na	na	na	na	na	na
R squared				0.593			na		
Observations				8,713			8,713		

[a] ratings are for passengers accessing/egressing by bus which had a sample = 701 (8% of the total). * denotes a multiplicative interaction.

6.30 Station attribute importance and comparison with Auckland Gravitas survey

Table 6.52 summarises the relative importance of the individual attributes in explaining the overall train station rating and compares the results with the same model estimated on the Gravitas Auckland satisfaction survey data. Importance was calculated by dividing each parameter by the sum of the parameters excluding the constant.

Table 6.52 Relative importance of individual train station attributes in explaining overall station rating

Variable	Pricing Strategies Linear	Pricing Strategies Logit	Gravitas Auckland
Weather Protection	13%	13%	11%
Platform Seating	11%	11%	12%
Platform Surface	9%	9%	na
Ease of getting To/From Platform	9%	9%	na
Timetable Info & Announcements	9%	9%	4%
Station Lighting	7%	7%	na
Station Cleanliness & Graffiti	18%	17%	37%
Toilet Availability & Cleanliness	1%	2%	na
Availability & Helfulness of Staff	2%	2%	na
Ability to buy food, drinks, paper	4%	4%	na
Ease of Ticket Purchase	8%	8%	na
Car Parking & Car Pick Up	7%	8%	na
Ease of Bus Transfer	1%	1%	na
Ease of boarding train	na	na	3%
Easy to get to (by car, walking)	na	na	20%
Personal Safety at Stop	na	na	13%
Total	100%	100%	100%

na not asked

As can be seen, the linear and logit models gave nearly identical results. Cleanliness/graffiti was the most important attribute explaining 17% to 18% of the overall rating with weather protection (13%) and seating (11%) second and third. There were then six attributes that each explained 7% to 9%: platform surface; ease of getting to/from the platform; information; ease of ticket purchase; lighting and car parking/car pick up facilities. Ability to buy food, drinks, paper etc explained around 4%, with staff, bus transfer and toilet availability/cleanliness of low order importance with each explaining 1% to 3% of the overall rating.

As with the bus stop ratings, a 'like-for-like' comparison with the Gravitas Survey was not possible because of the differences in the list of attributes and descriptions. The average overall station rating was 76% with the attribute ratings ranging from 66% for seating to 79% for ease of boarding. Cleanliness and graffiti was the most important explanatory variable of the overall rating (split into two attributes in the Gravitas survey) accounting for 37% of the overall rating. Second was 'easy to get to' at 20% with personal safety explaining 13%. Thus as in the pricing strategies study, cleanliness and graffiti was the most important explanatory factor.

6.31 Effect of market segmentation on train station attribute importance

The basic model was extended (using the same approach used for bus stops) to allow for differences in respondent profile. Gender, journey purpose, socio-economic status, personal income, age group, frequency of use and wait time were assessed. Table 6.53 presents the interaction factors that were statistically significant at the 95% confidence level.

Table 6.53 Statistically significant market segmentation interactions and relative attribute importance

		Attribute Importance												
Category	Group	WP	Seat	Info	Lght	Cl&G	OnOf	PS	Toil	Stff	Ret	Tick	Car	Bus
1. Access Mode	Bus Accessers													+
	Car Accessers													
2. Journey Purpose	Education													
	Personal Busn						+							
	Company Busn													
	Shopping		+			-				+	-		-	
	VFR		-				+							
	Ent/Hol			+	-									
3.Age	Young (<18)					-	+					+		
	Old (64+)		-		+				-					
4. Gender	Female				+									
5. Socio-Econ Status	Student													
	Hse Person													
	Retired		+									-		
	Unemployed													
6. Income	$k p.a.													
7. Frequency of Use	Occasional													
	Rare													-
	Not Frequent													
8. Waiting Time	Short (≤5 mins)												+	
	Long (>10 mins)				+	-								

In model 1, which considered station access, passengers who travelled by bus to get to/from the station attached more importance to bus transfer facilities whereas respondents who walked, drove or used another access mode generally did not attach much importance to bus transfer facilities. There was no difference in attribute importance between ‘car accessers’ and other access mode users.

Several journey purpose effects (model 2) were significant. Respondents on personal business trips placed greater weight on the ease of getting to/from the platform. Those making shopping trips attached more importance to seating and staff and less importance on cleanliness and graffiti, retail and car access facilities. Respondents visiting friends and relatives placed more importance on ease of getting to and from the platform and less on station seating. Finally, passengers making trips for entertainment/holiday reasons attached more importance to information and less to lighting.

In model 3 which looks at age, younger passengers (<18) placed greater weight on ease of getting on/off the platform and on ticketing but less importance on cleanliness and graffiti. Older passengers (64+) were more interested in lighting than seating and toilets.

The gender model 4 ‘females and males’ are similar in their relative weightings of attributes except that females attached greater importance to station lighting than males.

Employment status (model 5) has little effect with the only significant differences being among retired passengers who attached more importance to seating and less importance to ticketing. Personal income (model 6) has no significant effect on attribute importance.

Model 7 looks at the effect of how often passengers used rail and found that passengers who only rarely used rail were less concerned about bus transfer than more frequent rail users (who were more likely to make bus transfer trips).

Finally, in terms of waiting time (model 8), respondents who only waited for a short time (≤5 mins) attached more importance to car access facilities and respondents with a longer wait (>10 mins) placed more weight on station lighting but less on cleanliness and graffiti.

6.32 Development of 'grand final' explanatory model of train station quality

The grand final model of rail station attribute importance is presented in table 6.54. Several of the effects described in the previous section became statistically insignificant when the market segment models were combined. Eleven interactions were significant and of these, five related to passengers on shopping trips and three to young people. The other two interactions were for females who attached more importance to lighting and infrequent users who attached less importance to bus facilities.

Table 6.54 Grand final model of train station attribute importance

Variable	Linear			Logit		
	β	STE	|t|	β	STE	|t|
Weather Protection (WP)	0.126	0.008	15.8	0.577	0.044	13.1
Platform Seating (SEAT)	0.088	0.008	11.1	0.439	0.047	9.3
Platform Surface	0.083	0.009	9.7	0.391	0.048	8.2
Ease of getting To/From Platform	0.088	0.008	11.0	0.417	0.045	9.2
Timetable Info & Announcements	0.086	0.007	12.1	0.386	0.037	10.4
Station Lighting (LGT)	0.053	0.008	6.6	0.246	0.044	5.5
Station Cleanliness & Graffiti (CG)	0.189	0.008	22.5	0.848	0.047	18.2
Toilet Availability & Cleanliness	0.012	0.007	1.7	0.096	0.034	2.8
Availability & Helfulness of Staff (STF)	0.020	0.006	3.2	0.086	0.032	2.7
Ability to buy food, drinks, paper (RET)	0.043	0.007	6.5	0.214	0.034	6.3
Ease of Ticket Purchase (TCK)	0.074	0.007	11.4	0.334	0.033	10.0
Car Parking & Car Pick Up (CAR)	0.072	0.006	12.2	0.361	0.030	12.1
Ease of Bus Transfer * Bus Access (BUS)	0.022	0.008	2.6	0.131	0.046	2.8
Shopping * SEAT	0.193	0.032	6.0	0.943	0.196	4.8
Shopping * CG	-0.077	0.028	2.8	-0.371	0.152	2.4
Shopping * STF	0.061	0.027	2.3	0.331	0.147	2.3
Shopping * RET	-0.101	0.026	3.8	-0.463	0.141	3.3
Shopping * CAR	-0.079	0.026	3.0	-0.388	0.134	2.9
Retired * SEAT	0.055	0.015	3.7	0.396	0.082	4.8
Female * LGT	0.021	0.005	4.0	0.107	0.025	4.2
Young * ON	0.052	0.019	2.7	0.201	0.121	1.7
Young * CG	-0.088	0.025	3.6	-0.373	0.151	2.5
Young * TCK	0.073	0.021	3.5	0.371	0.117	3.2
Infrequent Users * BUS	-0.090	0.039	2.3	-0.469	0.342	1.4
Constant (α)*	0.083	0.006	14.8	-1.957	0.035	55.9
R Squared		0.6			na	
Observations		8,712			8,712	

6.33 Comparison of bus stop and train stations

Most of the analysis reviewed the bus stop and train station ratings separately. This was primarily due to the longer list of rail attributes but also because only the bus rating questionnaire asked about attribute availability. Nevertheless the overall stop and station ratings, asked on both the rating and SP questionnaires, were comparable and to end this section a comparison is presented.

Figure 6.44 ranks the 75 aggregated bus stops and 87 station ratings in order of their overall rating and table 6.55 presents summary descriptive statistics. The ratings are not strictly in order since they were pre-sorted by type. Bus stops were classified into bus stations, city centre and suburban stops. Train stations were classified into rail hubs, major stations and local train stations. In the graph, the observations are coded by colour and shape.

Figure 6.44 Ranking of bus stops and train stations by type and overall rating

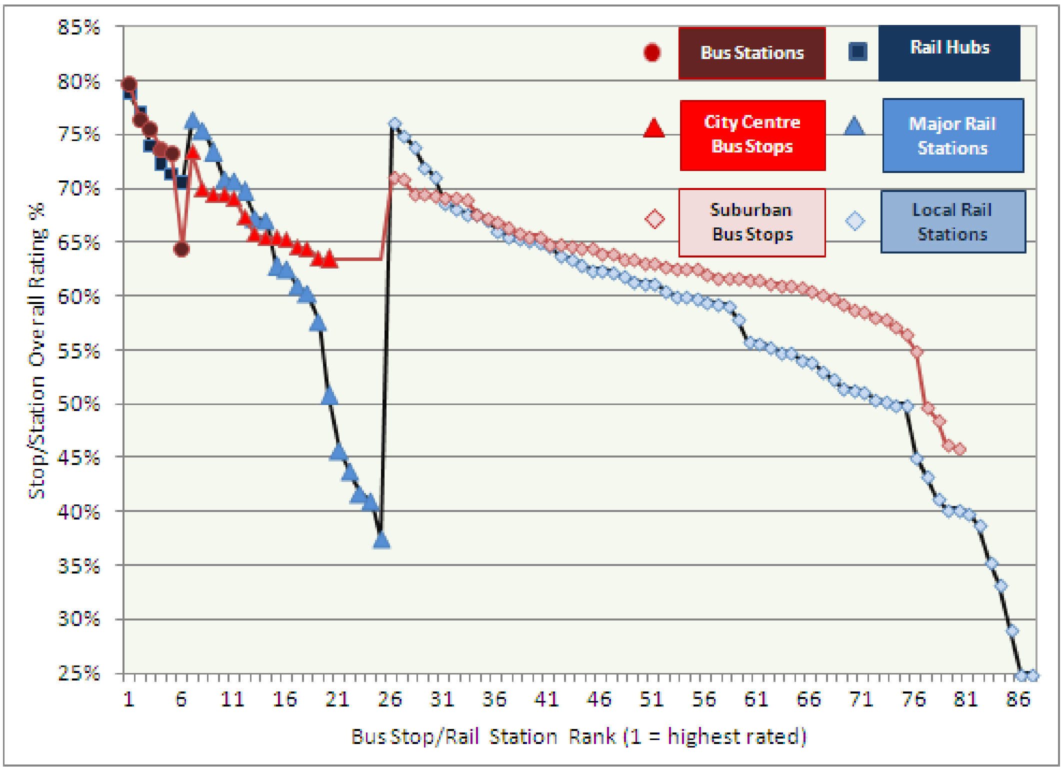


Table 6.55 Comparison of bus stop and train station ratings

Mode	Category	Average	Median	High	Low	StDev	Number
Rail	Hub	74%	73%	79%	71%	3%	6
Rail	Major	60%	63%	76%	38%	13%	19
Rail	Local	56%	59%	76%	25%	12%	62
Rail	All	58%	61%	79%	25%	12%	87
Bus	Station	74%	75%	80%	64%	5%	6
Bus	City Centre	67%	66%	73%	63%	3%	14
Bus	Suburban	62%	63%	71%	46%	6%	55
Bus	All	64%	64%	80%	46%	6%	75

The six bus stations and six hub train stations rated the highest and scored similarly at 74%. There was a greater range in the bus station ratings from 80% at Albany Northern Expressway station down to 64% for Wellington Airport. The six hub train stations ranged from 79% at Newmarket down to 71% at Porirua.

There was some overlap in the ratings with the highest city centre bus stops rating higher than the lowest bus stations and likewise for the major and hub train stations. The highest rated city centre bus stop was Courtenay Place at 73% which was on a par with Britomart. The highest rated major train station was Waikanae at 76% which was 2% above ‘hub’ station Paraparaumu on 74%.

There was a much wider variation in the major train station ratings than in the city centre bus stop ratings. The major rail ratings ranged 38% from 76% down to Taita on 38% whereas the city centre bus stops ranged by only 10% from 73% down to 63% at Manner Street in Wellington. The standard deviation at 3% was only a quarter that for major train stations at 13%. At 67%, the average city centre bus stop was rated 7% higher than the average major train station which scored 60%. The median ratings were closer at 66% and 63% respectively.

Again there was some overlap in the ratings with suburban bus stops and local train stations. The highest rated local train station was Naenae which had recently been upgraded. Naenae scored 76% which placed it equal third with Waikanae. The highest rated suburban bus stop was Mt Eden on 71% which ranked it the seventh highest bus stop with only one 'city centre' bus stop (Courtenay Place) rating higher. The range in the rating of suburban bus stops was 25% from 71% down to 46% at Churton Park. The range in local train station ratings was much wider from 76% down to 25% at Manor Park and Ava stations in Wellington. Comparing the average ratings, suburban bus stops scored 62% compared with 56% for local train stations. The median ratings were closer at 63% and 59%.

Overall, the analysis shows that the best train stations and best bus stops were similarly rated with train stations having a slight edge for major and local train stations over city centre and suburban bus stops respectively. However, low ratings for some train stations brought the average down to below that of bus stops. The data therefore suggests there is little evidence to value the average train station higher than the average bus stop.

7 Willingness to pay – analysis of the stated preference survey

7.1 Introduction

The aim of the stated preference (SP) survey was to estimate willingness-to-pay valuations of service quality. The approach built on work by Douglas and Karpouzis (2006a). Douglas and Karpouzis developed a rating approach that was used by RailCorp NSW to evaluate rolling stock and station refurbishment programmes. Where the current research departs from Douglas and Karpouzis is in the use of SP trade-off questions to derive the willingness to pay for bus/train and stop/station quality instead of a 'stated intention' type questions.

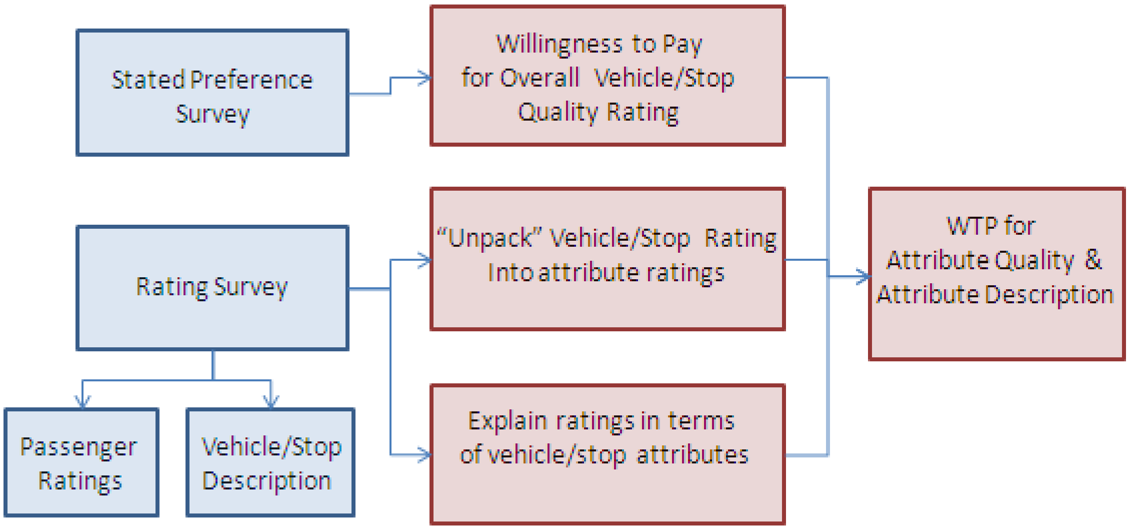
The approach involved two surveys:

1 The passenger rating surveys described in chapters 5 and 6 which explain the vehicle and stop/station ratings

2 A SP survey to develop willingness-to-pay measures for stop/station and vehicle ratings.

Figure 7.1 presents an overview of the SP analysis.

Figure 7.1 Quality study market research approach



Section 7.2 describes the questionnaire, pairwise show cards and experimental design with section 7.3 giving the sample sizes.

An aggregate analysis of the response based on the percentage of respondents who chose service A rather than service B is presented in section 7.4. Section 7.5 shows that the response to stop and vehicle quality was non-linear with greater sensitivity to very poor and poor than good and very good. The estimated relationships were used in all subsequent analysis. Section 7.6 looks at the percentage of respondents who did not trade off, always choosing the quicker mode or the cheaper mode rather than varying their response through the choice situations.

The rest of the analysis is disaggregated. Section 7.7 describes the analytical technique and section 7.8 presents the basic model. Sections 7.9 to 7.18 then fit models to various segmentations of the data such as time period, trip length and journey purpose.

The market segment models establish that the sensitivity to vehicle quality increases with trip length; service interval sensitivity increased with service frequency; and the sensitivity to IVT and to vehicle quality increased with income. Accordingly in section 7.19, the model is standardised for these four effects.

In section 7.20 the estimated value of IVT is presented and reviewed against the EEM and ATC (2006) guidelines. Likewise in section 7.21 the value of service interval is reviewed and in sections 7.22 and 7.23, the values of stop quality and vehicle quality are presented.

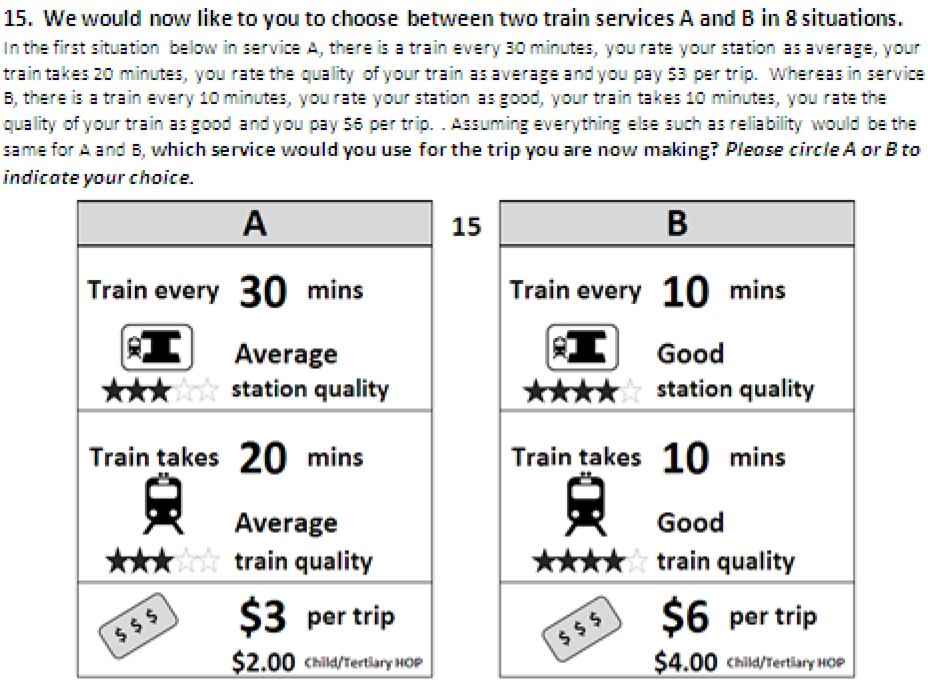
In section 7.24 an interaction model is fitted which relates IVT and vehicle quality on the one hand and service interval and stop quality on the other. In section 7.25 the resultant time multipliers are presented.

Finally in section 7.26 three 'super models' are presented. The first super model is fitted without any quality/time relationships. The second model allows for vehicle quality to interact with onboard time and the third model allows for stop quality to vary with service interval.

7.2 Overview of the stated preference survey

The SP survey presented bus and train users with a series of pair-wise choices. An example show card is presented in figure 7.2. The example is the first SP question in the booklet which included an explanation of the task and the choice. The subsequent choices only presented the choice.

Figure 7.2 Example stated preference show card



The survey was first implemented as an interviewer led face-to-face survey onboard trains and buses. Interviewing at stations was not considered because people had not experienced the vehicle quality. The method worked well on off-peak trains but difficulties were experienced on peak trains (because the interviewer had to stand in the aisle and lean over the passenger). It was very difficult interviewing onboard buses.

A self-completion questionnaire was therefore developed and tested. The most efficient and cost-effective size was an A4 sheet folded into a four-page A5 sized booklet. Pencils were offered to people to complete the questionnaire. The method worked best when fieldworkers gave short explanations of the SP task to passengers by opening the booklet and taking them through the first choice.

A five-star system was used (as for restaurant and film reviews) to describe stop/station and bus/train quality. Verbal descriptions were given to describe the quality level: one star was described as very poor, two poor, three average, four good and five very good. To familiarise people with the star system, the first page asked passengers to rate the stop/station they boarded at and the vehicle they were on.

The advantage of the five-point system over the nine-point system (used in the rating questionnaire) was that all the quality levels could be covered in the experimental design. As section 5.3 demonstrated, conversion between the two scales (5 and 9 point) was straightforward and analysis showed there was not a marked difference in the average ratings.

The SP design featured an underlying trade-off between fare and travel time. Thus as well as providing willingness-to-pay measures of vehicle and stop quality, the survey also provided values of onboard travel time. Service frequency (how often the buses depart) 'confounded' the time/cost trade-off. Sometimes the more frequent service was also quicker and sometimes it was cheaper.

Higher vehicle quality was associated with faster onboard travel times and higher fares. Stop quality was also varied so that sometimes the higher stop quality service was more frequent and sometimes less frequent.

All the attributes were specified in an underlying experimental design so that the fares, times and quality levels were uncorrelated. The attributes could take one of five levels. A full design would therefore have required 3,125 pairwise choices (5^5) and, if each respondent completed eight questions, 390 respondents would have been required for a complete replication. Such a design was considered too complicated for a self-completion paper questionnaire. Instead a fractional design was used.[60]

Four designs were tested in the pilot survey phase. The final design is presented in table 7.1. On the left of the table, the levels (0,1,2,3 and 4) are shown and on the right, the differences in onboard time (minutes), service interval (minutes), cost ($) and quality (rating point difference) are shown (service A minus service B).

The levels in table 7.1 are in order of the experimental design short distance bus trips in Wellington. The show cards presented to passengers were not shown in this order but were randomised. For example, experiment choice 1 was SP show card number 7. One half of the cards were then swapped around (with A becoming B and vice versa) so that the expensive mode was not always on the right. Swapping the cards was done to get respondents to look at the cards more carefully.

Finally, where attributes were the same in both service A and B as in SP experiment 1, they were not shown. Passengers were asked to assume the same quality and frequency as on their service when surveyed. As an example figure 7.3 presents SP 1 (show card 7 and questionnaire question number 21) which was a simple travel time and fare trade-off for the Wellington bus medium. Respondents were effectively being asked whether they would pay $1 to save eight minutes. In other words, was their value of onboard time greater or less than $7.50/hour?

To avoid respondent fatigue, the SP questions were allocated to three questionnaires. Two questionnaires had eight SPs and the third questionnaire had nine.

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[60] A fractional design is where the main effects are not independent of the interactions between attributes.

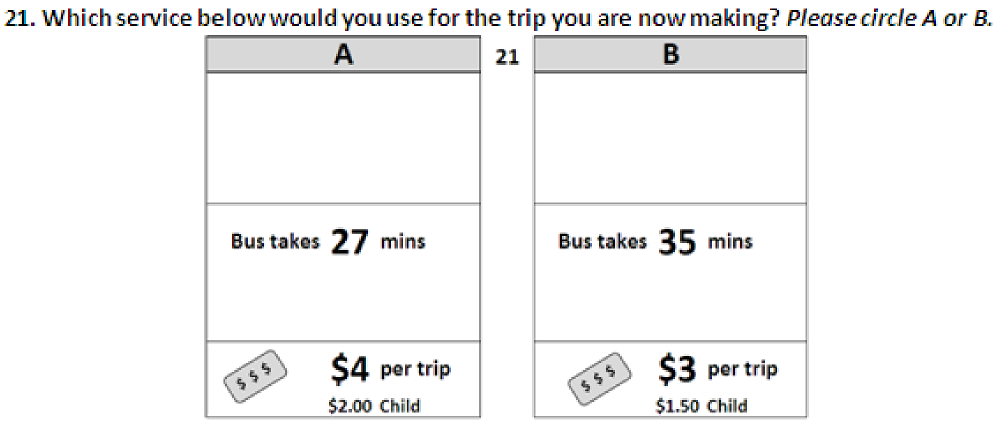
The 'levels' in the experimental design were specified as 'differences' between service A and B. By adding a constant amount to the times and fares of both services, the design was customised to the journeys that passengers were making when surveyed. Given that the underlying design was left unaltered (ie the same differences applied), the data obtained for all the designs could be pooled during analysis.

Table 7.1 Main survey experimental design Wellington bus medium design

EXP	Service A					Service B				
#	Freq	Stop	IVT	Vehicle	Fare	Freq	Stop	IVT	Vehicle	Fare
1	As Now	As Now	27	As Now	4.00	As Now	As Now	35	As Now	3.00
2	As Now	Very poor	25	Average	5.00	As Now	Average	35	Poor	3.00
3	As Now	Good	25	Very good	6.00	As Now	Average	40	Average	2.00
4	As Now	Average	25	Average	6.00	As Now	Poor	45	Very poor	3.00
5	As Now	Average	25	Good	5.00	As Now	Very good	30	Average	3.00
6	40	As Now	25	Average	5.00	20	As Now	35	Very poor	3.00
7	40	Very poor	25	Good	4.00	20	Average	40	Average	3.00
8	40	Good	25	As Now	5.00	20	Average	45	As Now	3.00
9	40	Average	25	Average	6.00	20	Poor	30	Poor	2.00
10	40	Average	27	Very good	6.00	20	Very good	35	Average	3.00
11	20	As Now	25	Average	6.00	10	As Now	40	Poor	3.00
12	20	Very poor	25	Very good	5.00	10	Average	45	Average	3.00
13	20	Good	25	Average	4.00	10	Average	30	Very poor	3.00
14	20	Average	27	Good	5.00	10	Poor	35	Average	3.00
15	20	Average	25	As Now	6.00	10	Very good	35	As Now	2.00
16	20	As Now	25	Good	6.00	30	As Now	45	Average	2.00
17	20	Very poor	25	As Now	6.00	30	Average	30	As Now	3.00
18	20	Good	27	Average	5.00	30	Average	35	Poor	3.00
19	20	Average	25	Very good	4.00	30	Poor	35	Average	3.00
20	20	Average	25	Average	5.00	30	Very good	40	Very poor	3.00
21	10	As Now	25	Very good	5.00	30	As Now	30	Average	3.00
22	10	Very poor	27	Average	6.00	30	Average	35	Very poor	2.00
23	10	Good	25	Good	6.00	30	Average	35	Average	3.00
24	10	Average	25	As Now	5.00	30	Poor	40	As Now	3.00
25	10	Average	25	Average	4.00	30	Very good	45	Poor	3.00

QualSP_ProcData1!EXZPDesign

Figure 7.3 Quality stated preference fare – travel time trade-off (exp #1)



The base bus times, fares and service intervals were designed around typical travel times, service intervals and fares. For fare, the availability of fare discounts for children and students was taken into account.

7.3 Survey designs and sample sizes

A total of 22 SP designs were used to cater for the range of travel times and fares. Appendix L (see part 3 of this report) presents the fares, onboard times and service intervals used. Table 7.2 lists the designs and presents the sample details. As each design required three questionnaires to present all 25 show cards, a total of 66 questionnaires were used.

A total of 39,865 responses were obtained from 5,356 questionnaires. This total includes the pilot survey responses where the attribute quality levels, times and costs were the same as in the main survey.

The average number of responses per questionnaire was 7.4, the number varied from 6.5 for Wellington rail medium (the average was lowered by including the pilot surveys) to 8.7 for the Christchurch medium – airport design which had only three responses and was therefore aggregated with Christchurch medium – outer.

Five designs had low sample sizes and were aggregated which reduced the number of designs to 15. The aggregation is shown on the right of the table.

Table 7.2 Stated preference sample sizes by questionnaire design

#	Code	City	Mode	Trip Length	Sample Sizes Q'aires	SP Obs	SP Obs / Q'aire	Agg Code	Agg Code
1	CBS	Christchurch	Bus	Short	533	3,960	7.4	1	CBS
2	CBM	Christchurch	Bus	Medium	162	1,248	7.7	2	CBM
3	CBMO	Christchurch	Bus	Medium - Outer	92	707	7.7	3	CBMO
4	CBMA	Christchurch	Bus	Medium - Airport	3	26	8.7	3	CBMO
5	WBS	Wellington	Bus	Short	526	3,908	7.4	4	WBS
6	WBM	Wellington	Bus	Medium	406	3,164	7.8	5	WBM
7	WBMH	Wellington	Bus	Medium - Hutt	13	100	7.7	6	WVF
8	WBVM	Wellington	Bus	Medium - Valley Flyer	128	980	7.7	6	WVF
9	WBVL	Wellington	Bus	Long - Valley Flyer	17	134	7.9	6	WVF
10	WBAS	Wellington	Bus	Airport Express Short	67	529	7.9	7	WBA
11	WBAM	Wellington	Bus	Airport Express Medium	52	412	7.9	7	WBA
12	WBAL	Wellington	Bus	Airport Express Long	36	251	7.0	7	WBA
13	WRS	Wellington	Rail	Short	341	2,458	7.2	8	WRS
14	WRM	Wellington	Rail	Medium	415	2,715	6.5	9	WRM
15	WRL	Wellington	Rail	Long	281	2,187	7.8	10	WRL
16	WRY	Wellington	Rail	Long - Wairarapa	44	312	7.1	10	WRL
17	ALP	Auckland	Bus	Link	90	647	7.2	11	ABS
18	ABS	Auckland	Bus	Short	859	6,321	7.4	11	ABS
19	ABM	Auckland	Bus	Medium	932	7,092	7.6	12	ABM
20	ARS	Auckland	Rail	Short	104	774	7.4	13	ARS
21	ARM	Auckland	Rail	Medium	101	750	7.4	14	ARM
22	ARL	Auckland	Rail	Long	154	1,190	7.7	15	ARL
ALL					5,356	39,865	7.4		

Table 7.3 presents the response to the 25 individual SP questions by aggregated design. In general the response was well balanced with similar numbers completing each question. The average number of responses for each of the 25 SP questions was 1,595 ranging from 1,538 to 1,679. The lowest number of responses for any question was 27 for Christchurch medium – outer. Table 7.4 presents the percentage choosing service A by SP question and aggregated design and figure 7.4 graphs the overall response. The design was reasonably balanced with an overall percentage of 44% choosing A.

Table 7.3 Response to stated preference question by aggregated stated preference design

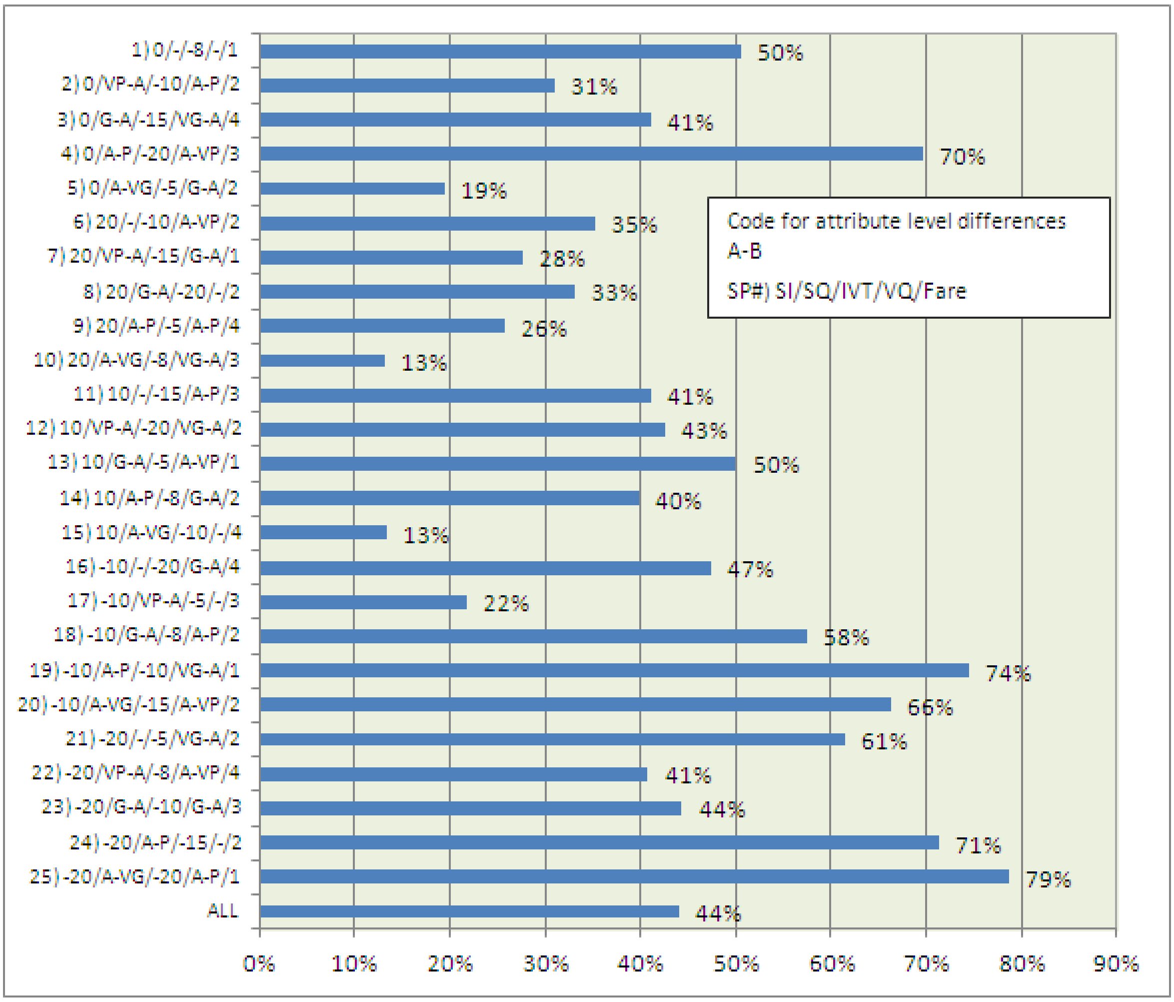
#	SI Dif	Stop Qual	IVT Dif	Veh Qual	Fare Dif	1 CBS	2 CBM	3 CBMO	4 WBS	5 WBM	6 WVF	7 WBA	8 WRS	9 WRM	10 WRL	11 ABS	12 ABM	13 ARS	14 ARM	15 ARL	ALL
1	0	*	-8	*	1	168	49	27	163	122	54	47	100	104	106	283	308	32	30	40	1,633
2	0	VP-Av	-10	Av-P	2	148	53	29	140	130	47	47	99	104	94	276	273	32	32	53	1,557
3	0	G-Av	-15	VG-Av	4	171	49	27	161	120	54	46	102	104	108	286	309	34	30	40	1,641
4	0	Av-P	-20	Av-VP	3	147	52	28	142	130	45	49	99	103	94	275	274	32	32	53	1,555
5	0	Av-VG	-5	G-Av	2	143	48	29	145	131	45	49	100	102	94	269	275	31	32	53	1,546
6	20	*	-10	Av-VP	2	141	49	29	143	129	44	48	96	108	92	270	275	29	32	53	1,538
7	20	VP-Av	-15	G-Av	1	143	49	29	143	131	44	49	98	108	94	272	276	31	32	53	1,552
8	20	G-Av	-20	*	2	175	49	27	164	125	50	46	99	111	107	291	310	30	28	41	1,653
9	20	Av-P	-5	Av-P	4	170	49	27	163	121	54	46	96	110	105	284	307	30	28	40	1,630
10	20	Av-VG	-8	VG-Av	3	144	52	30	149	131	44	48	101	106	94	272	274	30	32	53	1,560
11	10	*	-15	Av-P	3	168	49	27	160	123	53	48	97	110	104	284	309	33	30	40	1,635
12	10	VP-Av	-20	VG-Av	2	161	50	32	162	125	47	47	92	120	100	279	272	31	28	48	1,594
13	10	G-Av	-5	Av-VP	1	156	50	32	163	126	47	47	91	120	99	277	265	31	29	48	1,581
14	10	Av-P	-8	G-Av	2	164	51	33	165	127	47	46	95	119	101	285	272	30	29	48	1,612
15	10	Av-VG	-10	*	4	145	50	30	147	131	46	50	99	111	94	275	276	31	32	54	1,571
16	-10	*	-20	G-Av	4	172	49	27	166	125	53	47	103	103	108	287	309	30	28	41	1,648
17	-10	VP-Av	-5	*	3	144	51	32	147	133	46	50	98	113	94	276	278	31	32	54	1,579
18	-10	G-Av	-8	Av-P	2	147	52	29	142	131	46	50	97	104	94	274	272	32	33	53	1,556
19	-10	Av-P	-10	VG-Av	1	162	50	31	162	125	49	47	97	108	103	276	268	32	29	49	1,588
20	-10	Av-VG	-15	Av-VP	2	173	48	27	163	124	54	47	103	104	108	283	308	30	28	40	1,640
21	-20	*	-5	VG-Av	2	162	51	33	163	126	47	48	97	111	99	280	265	31	29	48	1,590
22	-20	VP-Av	-8	Av-VP	4	159	49	29	159	123	48	47	96	107	97	270	269	30	28	48	1,559
23	-20	G-Av	-10	G-Av	3	178	49	27	172	126	54	50	105	102	110	293	312	29	29	43	1,679
24	-20	Av-P	-15	*	2	161	50	30	160	125	49	47	97	109	100	275	271	31	29	49	1,583
25	-20	Av-VG	-20	Av-P	1	158	50	32	164	124	47	46	101	114	100	276	265	31	29	48	1,585
ALL						3,960	1,248	733	3,908	3,164	1,214	1,192	2,458	2,715	2,499	6,968	7,092	774	750	1,190	39,865

* as now for both A and B

Table 7.4 Percentage choosing service A by question and aggregated stated preference design

#	SI Dif	Stop Qual	IVT Dif	Veh Qual	Fare Dif	1 CBS	2 CBM	3 CBMO	4 WBS	5 WBM	6 WVF	7 WBA	8 WRS	9 WRM	10 WRL	11 ABS	12 ABM	13 ARS	14 ARM	15 ARL	ALL
1	0	*	-8	*	1	54%	39%	37%	64%	44%	41%	74%	64%	45%	48%	48%	44%	66%	53%	55%	50%
2	0	VP-Av	-10	Av-P	2	23%	19%	14%	27%	32%	38%	40%	47%	39%	59%	28%	24%	28%	22%	32%	31%
3	0	G-Av	-15	VG-Av	4	33%	33%	30%	39%	49%	31%	61%	42%	49%	50%	37%	40%	47%	50%	43%	41%
4	0	Av-P	-20	Av-VP	3	54%	56%	75%	76%	73%	78%	88%	78%	83%	89%	68%	57%	75%	63%	74%	70%
5	0	Av-VG	-5	G-Av	2	20%	15%	10%	22%	17%	22%	22%	19%	19%	29%	21%	18%	6%	19%	17%	19%
6	20	*	-10	Av-VP	2	26%	18%	17%	24%	34%	48%	40%	53%	44%	62%	33%	30%	48%	31%	40%	35%
7	20	VP-Av	-15	G-Av	1	19%	22%	28%	20%	41%	25%	16%	35%	36%	36%	25%	30%	26%	19%	23%	28%
8	20	G-Av	-20	*	2	14%	24%	26%	29%	38%	34%	35%	35%	52%	49%	35%	29%	27%	50%	39%	33%
9	20	Av-P	-5	Av-P	4	18%	24%	22%	24%	13%	26%	20%	26%	33%	38%	32%	25%	20%	25%	33%	26%
10	20	Av-VG	-8	VG-Av	3	10%	12%	10%	13%	11%	14%	8%	20%	16%	26%	12%	12%	17%	3%	9%	13%
11	10	*	-15	Av-P	3	27%	33%	33%	41%	40%	36%	44%	45%	58%	54%	38%	41%	39%	53%	49%	41%
12	10	VP-Av	-20	VG-Av	2	34%	40%	34%	36%	52%	53%	60%	41%	45%	53%	45%	39%	29%	50%	35%	43%
13	10	G-Av	-5	Av-VP	1	45%	44%	44%	47%	36%	53%	53%	63%	61%	73%	49%	47%	42%	55%	44%	50%
14	10	Av-P	-8	G-Av	2	30%	33%	39%	35%	29%	38%	48%	66%	45%	65%	41%	32%	53%	41%	27%	40%
15	10	Av-VG	-10	*	4	11%	10%	17%	10%	8%	20%	18%	12%	19%	16%	16%	12%	16%	22%	11%	13%
16	-10	*	-20	G-Av	4	36%	37%	30%	56%	51%	45%	64%	49%	55%	55%	43%	44%	53%	54%	65%	47%
17	-10	VP-Av	-5	*	3	20%	16%	9%	30%	23%	28%	40%	13%	26%	14%	28%	17%	16%	13%	19%	22%
18	-10	G-Av	-8	Av-P	2	57%	50%	48%	55%	56%	59%	78%	62%	63%	76%	51%	49%	72%	52%	81%	58%
19	-10	Av-P	-10	VG-Av	1	70%	78%	58%	75%	76%	67%	96%	91%	77%	84%	70%	71%	66%	76%	67%	74%
20	-10	Av-VG	-15	Av-VP	2	58%	67%	41%	75%	73%	61%	77%	80%	73%	76%	58%	61%	63%	75%	78%	66%
21	-20	*	-5	VG-Av	2	57%	65%	39%	61%	61%	68%	79%	67%	59%	66%	65%	60%	55%	55%	44%	61%
22	-20	VP-Av	-8	Av-VP	4	39%	31%	17%	41%	27%	40%	78%	36%	36%	57%	48%	37%	47%	36%	38%	41%
23	-20	G-Av	-10	G-Av	3	39%	41%	33%	51%	34%	46%	58%	38%	45%	45%	47%	41%	62%	48%	62%	44%
24	-20	Av-P	-15	*	2	64%	66%	60%	69%	75%	59%	89%	82%	74%	77%	75%	69%	71%	76%	51%	71%
25	-20	Av-VG	-20	Av-P	1	72%	82%	78%	75%	81%	77%	91%	84%	86%	86%	77%	76%	74%	90%	69%	79%
ALL						38%	38%	34%	44%	43%	44%	55%	50%	50%	55%	44%	40%	45%	45%	43%	44%

Figure 7.4 Percentage choosing service A by question all observations



There was a slight preference for service B, which was cheaper but slower than service A. Over the whole sample 56% chose B and 44% chose A. Respondents using the Wellington Airport Express and Wellington long rail were the most likely at 55% to choose the faster but more expensive service A. Christchurch respondents were the most likely to choose service B and the least likely to choose service A (34% to 38%).

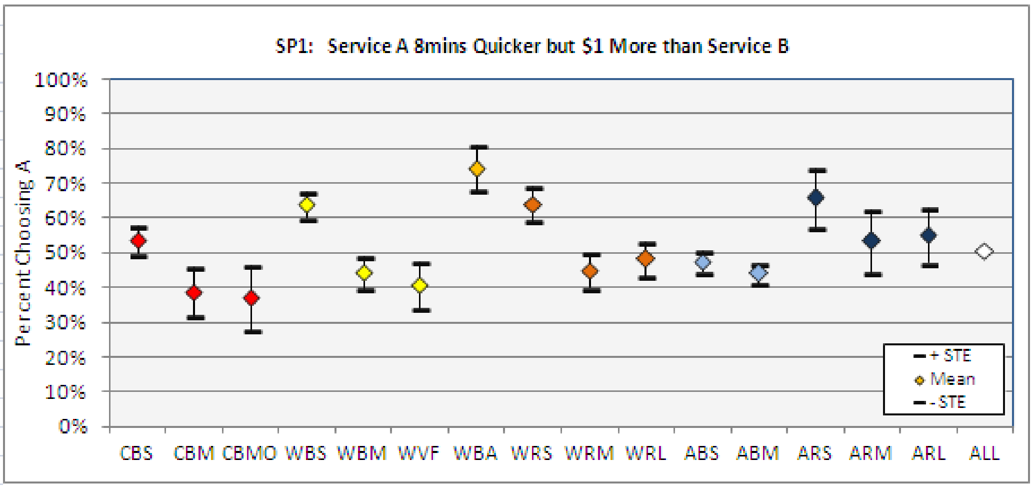
Figure 7.5 graphs the response to SP1 which was the 'pay $1 fare to save eight minutes trade-off' ie $7.50/hour value of time threshold (as shown in figure 7.3). As well as the mean percentage, the standard error (± 1 standard error) is graphed to show the sampling error in the estimate. The overall percentage choosing A was 50%. Thus the implied median value of time was $7.50/hour (ie 50% had a higher value and 50% a lower value).[61] For evaluation purposes it is worth noting that the value, as with all monetary values presented in this report unless otherwise stated, are in 'market prices'; that is they include indirect taxes, notably goods and services tax (GST), which is levied at 15%.

The percentage varied by route. Nearly three-quarters of the Wellington Airport Express respondents, who already pay a higher fare to use the premium service, chose the faster service. This made them the most

[61] This value of time is slightly inflated since no adjustment has been made for child and fare student discounts. This is done in the disaggregate analysis.

willing to pay to save time across the 15 market segments. Next highest were Auckland rail short, Wellington bus short and Wellington rail short with around two-thirds having a value of time over $7.50/hour. In fact, passengers completing a 'short' SP design were generally more likely to choose the quicker service (excluding Auckland bus users). Least likely to pay $1 to save eight minutes were Christchurch bus respondents completing the medium distance SP at just under 40%.

Figure 7.5 Fare – travel time trade-off (exp #1)



7.4 Graphical presentation of response to attribute levels

The percent choosing service A was aggregated by the attribute levels. Figure 7.6 presents the mean score graphs for service interval, IVT and fare. Appendix O (see part 3 of this report) presents graphs by aggregated SP design. The fare, onboard time (IVT) and service interval graphs slope downwards to the right indicating that as service A becomes more expensive or takes longer than B, fewer people choose it. All three graphs show relationships that are effectively linear.

Figure 7.6 Response to service interval travel time and fare – percent choosing service A by attribute level

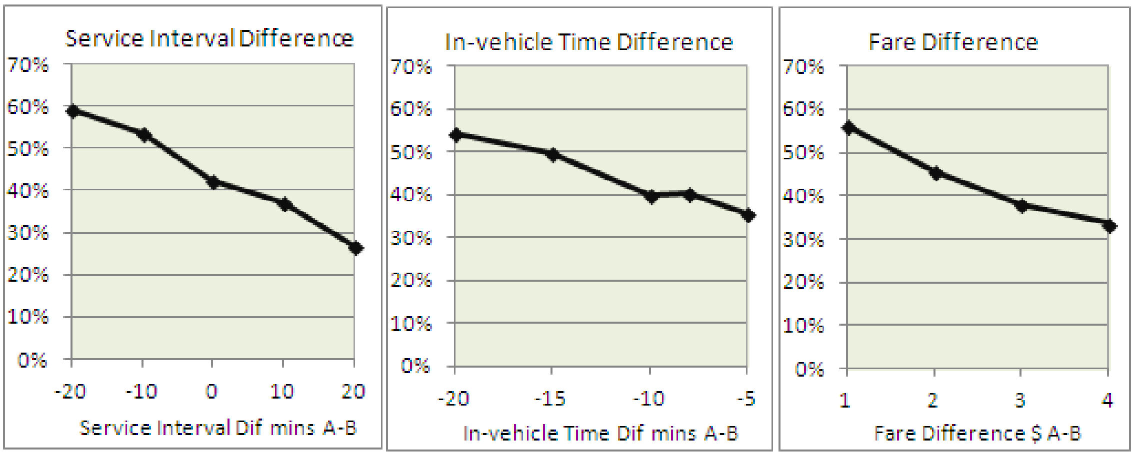
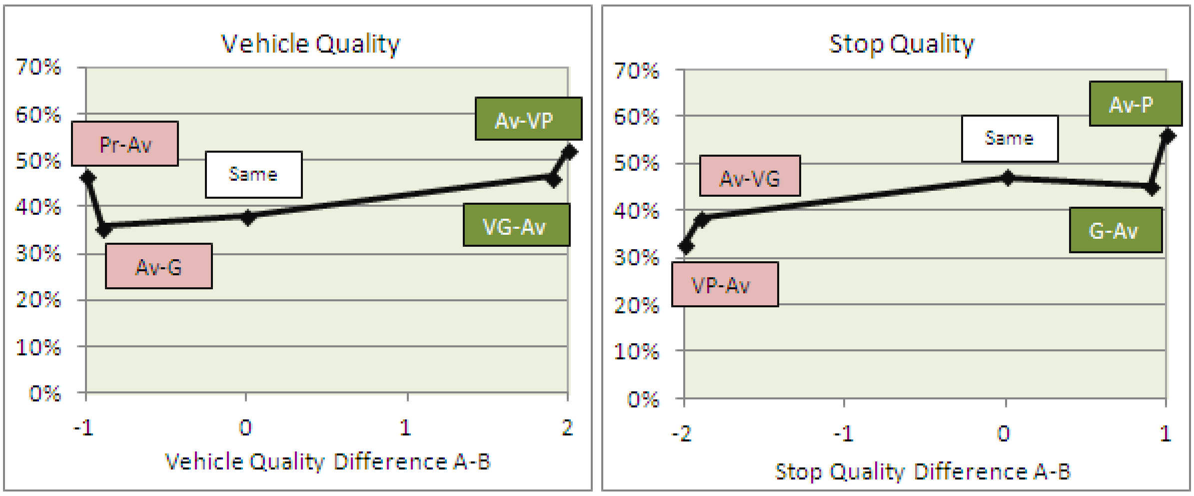


Figure 7.7 presents mean score graphs for stop/station and vehicle quality. The graphs slope the opposite way to the time and fare graphs reflecting the tendency for more people to choose service A as its quality improves relative to service B. To distinguish the vehicle quality levels on the graphs, the Av-G level was

set at -0.9 rather than -1 and VG-Av was set at 1.9 rather than 2. The same was done for the stop quality graph.

Figure 7.7 also shows the response to quality to be non-constant with respondents becoming less sensitive to differences in quality, the higher the quality. This was most pronounced for the very poor versus average stop quality comparison. The effect can be deduced from the 'Av-VG' level being closer vertically to the 'same' level than the 'VP-Av' level.

Figure 7.7 Response to stop and vehicle quality – percent choosing service A by attribute level



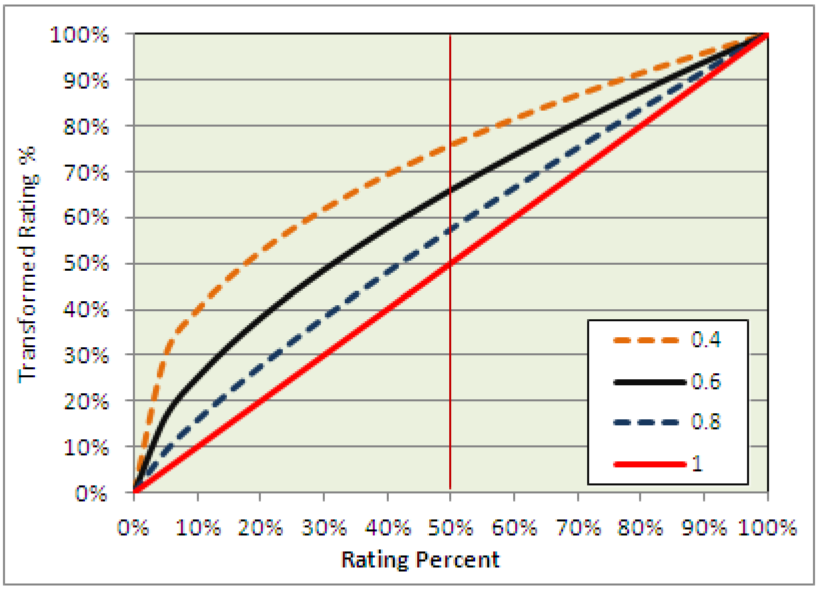
7.5 Taking account of quality non-linearity

Respondents were more sensitive to changes in quality measured from a poor rather than from a good base. To take account of this, the quality variables were transformed by applying a power function. Thus for vehicle quality *VQ)*, the transformed variable was VQ^{ε} where ϕ was a number between 0 and 1. The same transformation was applied to stop quality. If ϕ was 0, the transformed quality rating would be 100% for all the ratings excepting very poor. With ϕ set to 1, the vehicle quality rating would be left unaffected.[62]

Figure 7.8 shows the effect of the transformation parameter. With the range in power values shown (from 0.4 to 1) the transformed rating is the same as the 'base' rating at the 'end point' ratings of 0% (very poor) and 100% (very good). With a power parameter of 0.8, the 'average' rating of 50% is transformed to 57%. With a parameter of 0.6 it is transformed to 66% and with a parameter of 0.4 to 76%. Thus the smaller the power parameter, the greater the weight attached to low-quality ratings, with high ratings receiving less weight.

[62] Any number (greater than zero) raised to the power of zero is 1. Mathematicians debate the value of 0^0. Excel gives undefined. For the purposes of this study, a value of 0 is the most useful.

Figure 7.8 Quality 'power' function



To determine the appropriate power parameter for vehicle and stop/station quality a set of aggregate regressions was undertaken using equation 7.1.

$$Pa - 0.5 = \alpha + \beta_f \Delta F + \beta_t \Delta V + \beta_{si} \Delta SI + \beta_{vq} \left\{VQ_A^{\phi vq} - VQ_B^{\phi vq}\right\} + \beta_{sq}\left\{SQ_A^{\phi sq} - SQ_B^{\phi sq}\right\} \quad \text{(Equation 7.1)}$$

Where:

$Pa =$ proportion choosing A

$\Delta F =$ difference in fare in dollars per trip A-B

$\Delta V =$ difference in IVT in minutes A-B

$\Delta SI =$ difference in service interval (minutes between departures) A-B

$\Delta VQ =$ difference in bus/train quality rating

$\Delta SQ =$ difference in bus stop/train station rating

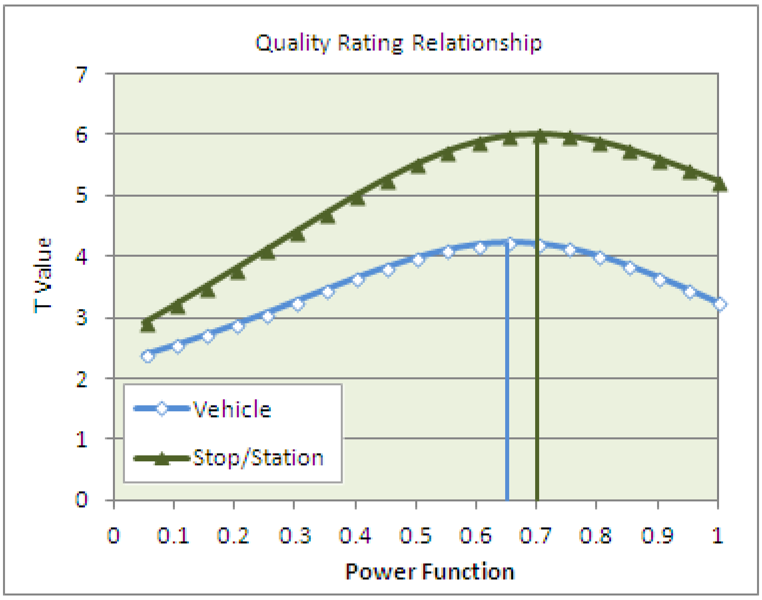
$\alpha, \beta_i \phi_i =$ parameters to be estimated

The observations were the proportions choosing service A for each of the 25 experiments. In theory, if there was no difference in the attributes (ie service A was the same as B in cost, time and quality) the proportion choosing A would be 0.5. However, if the design favoured one of the alternatives, for instance because the fare difference was set too high, a significant constant would be estimated. So that the regression could test the significance of any underlying preference, 0.5 was subtracted from the proportion choosing A.

Regressions were estimated with the power parameters varied from 0.05 to 1 at 0.05 increments and the |t| values (the ratio of the parameter estimate to the standard error).[63] Figure 7.9 plots the recorded t values for the 'All' respondent model. The value for the vehicle power parameter that maximised the |t|value was 0.65. For stop/station quality it was 0.7.

[63] The other attributes were unaffected since the design was orthogonal.

Figure 7.9 Vehicle and stop quality relationship with rating



Models were run for the each of the 15 (aggregated) SP designs. Table 7.5 presents the models which optimised the |t| values for vehicle and stop/station quality. The stop/station quality (SQ) parameter ranged from 0.5 for Auckland rail medium to 0.95 for Wellington bus medium. For vehicle quality (VQ), the parameter was lowest for Auckland rail medium at 0.35 and highest for Wellington bus medium and Christchurch bus medium at 0.9. On consideration, there appeared no clear pattern in the variation in the power parameters across the market segments and therefore the overall values were used in the disaggregate analysis.

Table 7.5 also presents the parameter values and |t| values for the attribute variables. The service interval parameter was the strongest with a |t| value of 8.1 for the overall model. Fare, IVT and stop quality were next highest with |t| values of 5 or more. Vehicle quality was the lowest with a |t| value of 3.2. The constant was the only parameter that was not statistically significant with a |t| value of 1.6 which was a desirable result as it meant that the design was well cast with the attribute levels explaining the variation in choice and no underlying and unattributed preference for service A or B.

Table 7.6 presents the relative attribute values. Four of the relative valuations are calculated with onboard time as the numeraire. These are: the value of a minute of service interval in equivalent IVT minutes ($\beta si/\beta v$); the value of very poor to very good stop/station quality in IVT minutes ($\beta sq/\beta v$); the same for vehicle quality ($\beta vq/\beta v$) and the relative valuation of the constant in onboard time minutes ($\alpha/\beta v$).

Also tabulated is the value of onboard time expressed in dollars per hour ($60\{\beta v/\beta f\}$). Figure 8.9 graphs the attribute relative valuations with the sampling error (± 1 standard error) shown. Formulae used to calculate the estimates are presented in appendix N (see part 3 of this report).

The overall value of time was $10.37/hour. The market segment values ranged from $4.94/hour for Christchurch bus short to $19.58/hour for Auckland rail long. The values are a little on the high side because the fare variable has not been adjusted for child/student discounts (which was done in the disaggregate analysis). The figures are also marginal valuations based on the 'incremental' willingness to pay for 'incremental' time savings as calculated by the ratio of two slopes (the IVT and fare β parameters).

The figures are also mean values that compare with the median value of $7.50/hour (figure 7.5) derived from the simple fare – on-board time trade-off question. The higher mean compared with the median can be attributed to (i) different proportions of 'non traders off' and (ii) a longer 'upper tail' in the distribution of values of time.

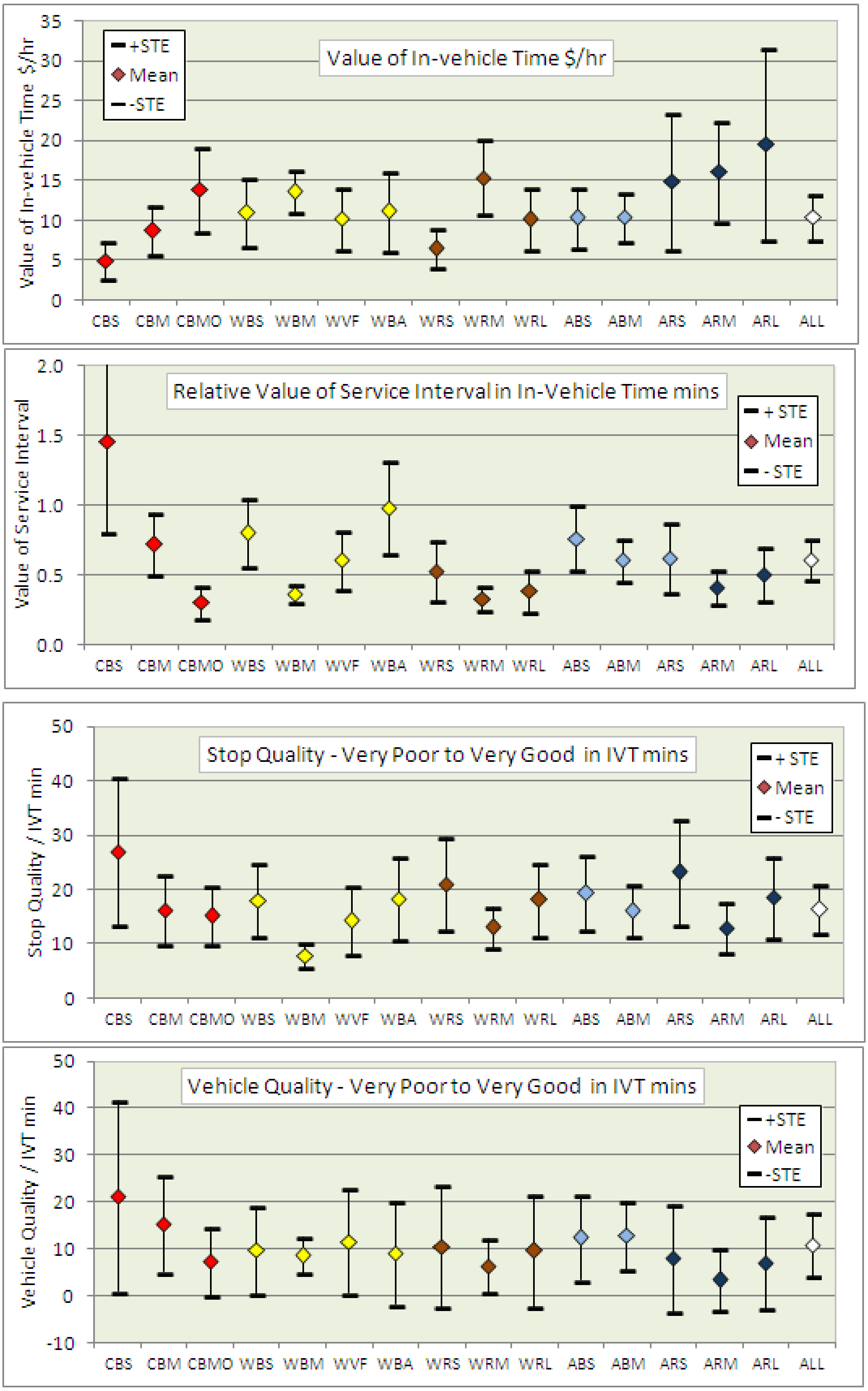
Table 7.5 Aggregate stated preference regression results

#	Mkt	Power Parm		Beta Parameter						|t| value						R^2
		SQ	VQ	βo	SQ	VQ	SI	V	F	βo	SQ	VQ	SI	V	F	
1	CBS	0.70	0.65	-0.34	0.83	1.13	-0.04	-0.03	-0.37	1.3	3.9	3.0	8.9	2.3	5.3	0.35
2	CBM	0.70	0.90	-0.58	0.96	1.34	-0.04	-0.06	-0.41	1.8	3.7	2.9	6.8	3.6	4.7	0.44
3	CBMO	0.60	0.60	-0.95	1.24	0.69	-0.02	-0.08	-0.36	2.4	4.0	1.2	3.3	4.1	3.4	0.53
4	WBS	0.60	0.55	-0.40	1.01	0.97	-0.05	-0.06	-0.31	1.3	4.0	2.1	7.5	3.5	3.7	0.43
5	WBM	0.95	0.90	-0.75	0.82	1.26	-0.04	-0.1	-0.46	3.0	4.1	3.5	7.9	8.2	6.9	0.34
6	WVF	0.70	0.60	-0.45	0.74	1.32	-0.03	-0.05	-0.31	1.5	3.1	3.1	5.5	3.5	3.9	0.40
7	WBA	0.85	0.65	0.09	1.30	1.40	-0.07	-0.07	-0.38	0.2	3.7	2.2	8.2	3.1	3.3	0.60
8	WRS	0.65	0.65	0.30	1.30	1.69	-0.03	-0.06	-0.58	0.7	4.1	2.9	4.3	3.1	5.5	0.54
9	WRM	0.60	0.55	-0.40	1.12	0.99	-0.03	-0.09	-0.34	1.3	4.6	2.2	4.8	5.5	4.1	0.42
10	WRL	0.65	0.65	-0.11	1.23	2.17	-0.03	-0.07	-0.4	0.3	4.1	4.0	3.6	3.6	4.1	0.51
11	ABS	0.75	0.60	-0.33	0.94	0.81	-0.04	-0.05	-0.28	1.2	4.5	2.1	7.4	3.7	4.1	0.35
12	ABM	0.75	0.75	-0.57	0.93	1.11	-0.04	-0.06	-0.34	2.3	4.8	3.2	7.6	4.7	5.3	0.33
13	ARS	0.75	0.50	-0.56	1.43	1.01	-0.04	-0.06	-0.25	1.3	4.2	1.7	4.7	2.9	2.2	0.57
14	ARM	0.50	0.35	-0.56	1.32	0.47	-0.04	-0.1	-0.38	1.2	3.6	0.7	4.8	4.4	3.2	0.61
15	ARL	0.70	0.50	-0.78	1.30	1.04	-0.04	-0.07	-0.22	1.8	3.8	1.7	4.3	3.2	1.9	0.58
16	ALL	0.70	0.65	-0.38	0.98	1.10	-0.04	-0.06	-0.35	1.6	5.2	3.2	8.1	5.0	5.6	0.32

Table 7.6 Relative valuations and standard errors

#	Mkt	Relative Valuations					Standard Error				
		VOT $/hr	SI/V	SQ/V	VQ/V	βo/V	VOT $/hr	SI/V	SQ/V	VQ/V	βo/V
1	CBS	4.94	1.46	27.0	21.2	11.0	2.34	0.66	13.60	20.29	9.89
2	CBM	8.71	0.72	16.2	15.2	9.8	3.05	0.23	6.30	10.17	6.19
3	CBMO	13.82	0.30	15.1	7.3	11.6	5.22	0.12	5.26	7.16	5.56
4	WBS	10.91	0.80	17.9	9.7	7.1	4.24	0.25	6.71	9.35	5.95
5	WBM	13.60	0.36	7.8	8.6	7.2	2.57	0.06	2.13	3.76	2.58
6	WVF	10.16	0.60	14.3	11.6	8.6	3.92	0.21	6.13	11.03	6.26
7	WBA	11.10	0.98	18.2	9.1	-1.3	4.91	0.33	7.65	11.00	6.33
8	WRS	6.43	0.53	21.0	10.5	-4.8	2.41	0.21	8.57	12.87	6.68
9	WRM	15.37	0.33	13.0	6.4	4.6	4.66	0.09	3.70	5.57	3.70
10	WRL	10.15	0.38	18.1	9.5	1.6	3.78	0.15	6.69	11.92	5.56
11	ABS	10.32	0.76	19.3	12.3	6.8	3.78	0.23	6.78	8.97	5.72
12	ABM	10.38	0.60	16.0	12.9	9.8	2.95	0.15	4.73	7.23	4.67
13	ARS	14.85	0.62	23.2	8.1	9.1	8.44	0.25	9.74	11.41	7.61
14	ARM	16.17	0.41	12.9	3.4	5.4	6.29	0.13	4.58	6.49	4.64
15	ARL	19.58	0.50	18.5	7.1	11.0	11.98	0.20	7.52	9.92	7.04
16	ALL	10.37	0.61	16.3	10.8	6.4	2.78	0.14	4.50	6.73	4.15

Figure 7.10 Relative valuations – aggregate analysis



Section 7.6 looks at the proportion of non-traders in details and shows that more passengers always chose the cheaper option than the quicker option which would act to suppress the median value of time but leave the incremental value of time unaffected (since the constant term would pick up the effect).

A second reason is the probable presence of a longer 'upper tail' in the distribution of values of time whereby some passengers are willing to pay proportionately more to save time. Such an asymmetrical distribution would raise the mean more than the median value.

In terms of trip length, figure 7.10 shows a tendency for the value of time to increase with trip length reflecting a greater willingness to pay for a given time saving the longer the trip. By contrast, the service interval valuation declined with trip length. The overall SI/IVT value was 0.61 but for short bus trips it reached 1.46 (although with a high sampling error), for Christchurch whereas for medium bus trips the valuation was 0.72. There was less variation in the rail valuations: the lowest was 0.33 for Wellington medium trips and was highest at 0.62 for Auckland short trips.

The maximum value of stop quality (very poor to very good) was worth 16.3 minutes of in-vehicle time. There was no obvious trend for trip length or mode with the values ranging from 7.8 minutes for Wellington bus medium to 27 minutes for Christchurch bus short.

The maximum valuation of vehicle quality (very poor to very good) was worth 10.8 minutes ranging from 3.4 minutes for Auckland rail medium to 21.2 minutes for Christchurch bus short.

7.6 'Non-traders'

As section 7.2 described, the experimental design featured a fare versus time trade-off whereby service A was always quicker (and of higher vehicle quality) but more expensive than service B. Although the choices were designed to encourage respondents to vary their choice (ie by sometimes picking the cheaper option and sometimes the quicker option depending on the fares, times and other 'confounding' variations) it was possible for some respondents to 'always go' for the cheaper option or alternatively 'always go' for the quicker option. The percentage of these non-traders is considered useful in the broader context of developing pricing strategies as it indicates the relative numbers who always prefer cheap or always quick.

Table 7.7 and figure 7.11 present an analysis of respondent 'trading off'. The analysis was based on respondents who completed at least seven SP questions (around 90% of total response). For these respondents, 84% 'traded-off' by sometimes picking the cheaper option and sometimes the quicker option. Of the 16% who did not 'trade-off', 12% always picked the cheaper option and 4% always picked the quicker/higher quality option. Thus for non-traders off, the ratio was 3:1 in favour of the cheaper option.

Across the cities, Christchurch at 20% had a noticeably higher percentage who always picked the cheaper option. Next highest was 13% for Wellington rail. The highest percentage always picking the quicker/higher vehicle quality option was 8% for Auckland bus. In fact, Auckland bus 'non-traders' were evenly split between those always going for the cheaper option and those always going for the quicker option. For the other market segments, the percentage 'always going' for the quicker option was about half as large at 4%.

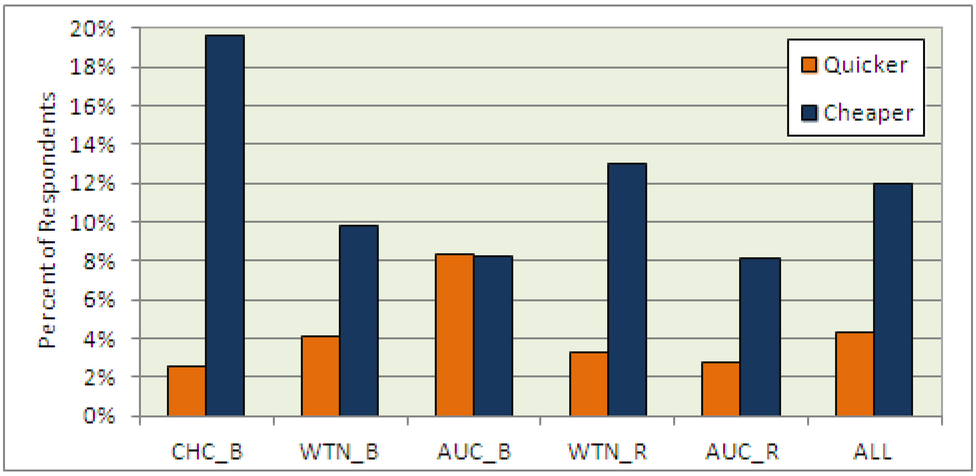
Table 7.7 Percentage 'not trading off' by market segment

Response	Bus				Rail			All
	CHC	WTN	AUC	All	WTN	AUC	All	All
Always quicker	3%	4%	8%	5%	3%	3%	3%	4%
Always cheaper	20%	10%	8%	12%	13%	8%	12%	12%
Trade-off	78%	86%	83%	83%	84%	89%	85%	84%
Sample[a]	666	1,078	853	2,597	1,610	295	1,905	4,502
Respondents[b]	759	1,197	1,002	2,958	1,765	334	2,099	5,057

[a] restricted to respondents who answered at least seven SP questions.

[b] At least one SP completed.

Figure 7.11 Percentage 'not trading off' by market segment

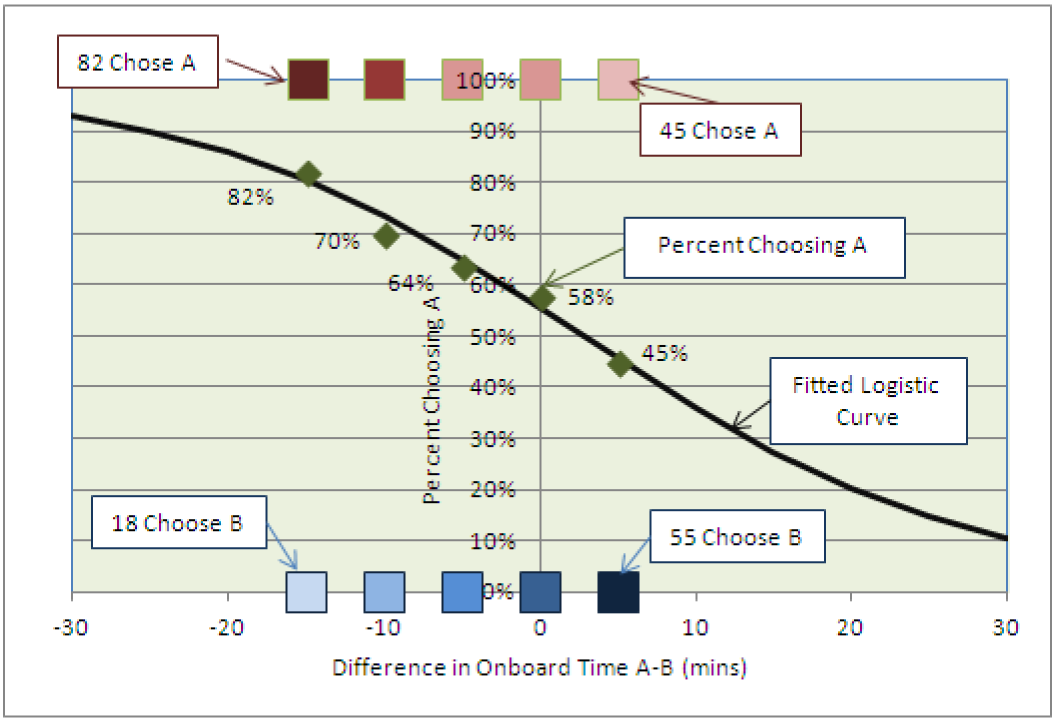


7.7 Disaggregate analysis

A logistic function was fitted to explain the 39,865 individual choices. Instead of a proportion, the choice data took either a value of one (if service A was selected) or zero (if B was selected). Where respondents said they were indifferent (51 cases), the response was coded twice with each observation weighted by one half.[64] Figure 7.12 illustrates the difference between aggregate and disaggregate data.

[64] This increased the number of observations to 39,970 although the application of the weights kept the sample size to 38,865.

Figure 7.12 Model fitting process



Douglas Economics MaxLEgPTT

Figure 7.12 shows five time differences (A-B).[65] With each respondent able to choose A or B, the number of choice-time combinations was 10. The 10 combinations are shown as squares that are either shaded red and placed at the top (100% A) to indicate that A was selected or are blue and placed at the bottom of the graph (0% A) if B was selected.

The intensity of the shading indicates the number of times A or B was chosen. For ease of presentation, 100 responses per level have been assumed rather than the actual samples. Thus, when A was 15 minutes quicker than B, 82 chose A and the red square is shaded darkly. Conversely only 18 chose train B so the blue square is correspondingly lightly shaded.

Moving leftwards along the top of the graph, the shading of the red squares gets lighter as fewer passengers choose train A in response to the onboard time for train B getting shorter. Conversely on the bottom of the graph, the shading gets darker as more passengers choose train B.

There are only five points for the grouped data which are shown as green diamonds. Thus, with A 15 minutes quicker, the percentage choosing A is 82% and with the train taking five minutes longer, the percentage reduces to 45%

The fitted curve is the result of the estimation process. The curve shows the probability of a respondent choosing A or B for a given time difference. A logistic function has been fitted. The logistic 'S' shaped function has the property that the probabilities are constrained to the 0-1 interval. The 'S' shaped curve contrasts with the straight lines shown in figure 7.6. However, even with a logistic function the relationship is approximately linear over the range 0.2 to 0.8. It is only outside this range that the curve bends noticeably away from a straight line.

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[65] In the actual quality SP survey, two of the onboard time levels were the same so there were only four different levels.

Mathematically, the probability of choosing train A was expressed as a logistic function whereby the dependent variable is transformed to a log odds ratio ($\ln\{P/(1-P)\}$. With grouped data, ordinary least squares (OLS) regression can be used to estimate the slope and constant parameters governing the fitted line.[66] OLS cannot be used for individual data where probabilities are 1 or 0. Instead, maximum likelihood estimation is used which seeks to find the parameter values that are most likely to have produced the observed responses (see for example Pindyck and Rubinfeld 1998).

7.8 Basic model

Equation 7.2 was used to model the individual choice data.

$$Pa = \frac{Z}{1+Z} \text{ where} \qquad \text{(Equation 7.2)}$$

$$Z = \exp\left\{ \begin{array}{l} \alpha + \alpha_c C + \beta_f \Delta F + \beta_v \Delta V + \beta_{si} \Delta SI + \\ \beta_{sq} \left\{ (1 - SQ_A{}^{0.7}) - (1 - SQ_B{}^{0.7}) \right\} + \beta_{vq} \left\{ (1 - VQ^{0.65}) - (1 - VQ^{0.65}) \right\} \end{array} \right\}$$

C = fare concession entitlement taking a value of 1 if entitled to a concession else zero.

The other variables were the same as described in equation 7.1.

Two changes were made to the aggregate analysis equation (equation 7.1). First, a concession variable was included that took account of whether respondents were entitled to the fare discount shown on the SP show card. For Wellington and Christchurch the fare discount was 50% and was applicable to children. For Auckland, the discounted fare was less at two-thirds of the standard fare but was available to students as well as children.[67]

The second change was specifying vehicle and stop quality as its mirror image (ie the 'lack of quality') which had the advantage that the expected sign for all the variables was negative. The power transformation parameters of 0.65 for vehicle and 0.7 for stop (estimated in section 7.5) were retained to transform the ratings.

The observations were weighted to balance the response to the 25 questions so that the design remained orthogonal. Without the balancing weights, some correlations would have been introduced (albeit small) between the attributes. Weighting was done for each of the 15 aggregated SP designs. Appendix M (see part 3 of this report) presents the formula and the weights, the maximum for which was 1.19.

The estimated parameters and t values are presented in table 7.8. All the attributes had the expected negative sign; fewer people chose the option the lower the time, cost or quality. They were also highly significant, far exceeding the 95% confidence threshold of 1.96. It should be noted that no adjustment was made for repeat observations (one respondent providing eight or nine observations). At the extreme, the t values would reduce by around 2.7 due to the number of observations reducing from 39,865 to 5,356;

[66] So long as all respondents do not go for one option which would mean that the proportion choosing train B would be zero and the odds ratio would be infinite.

[67] An alternative approach of multiplying the fare difference by the fare concession dummy variable (1,0) was tried but produced inferior results.

however, analysis of repeat observation effects in a similar large scale survey of the value of time for Sydney rail travel (Douglas Economics 2004b) found that adjusting for repeat observations had negligible effect.[68]

Relative parameter strength was the same as in the aggregate analysis. Service interval was the strongest with a |t| value of 36 in the overall model. Next strongest were onboard time, fare and stop quality with |t| values of around 30 followed by vehicle quality at 22. The concession fare parameter had a |t|value of 14.4 and the constant was the weakest with a |t| value of 7.8.

Table 7.8 Basic model

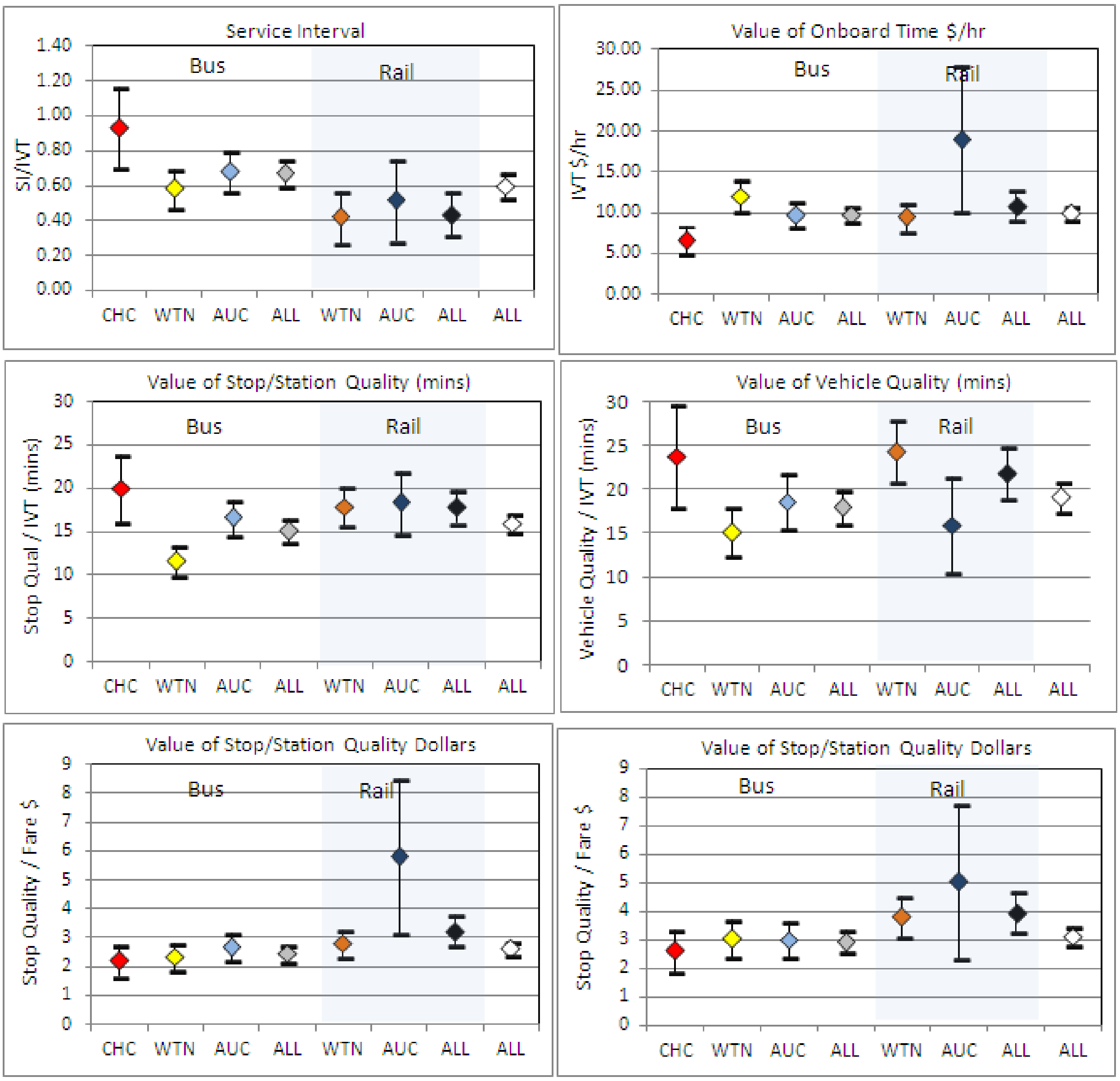
	Bus				Rail			ALL
Parameter Estimates	CHC	WTN	AUC	ALL	WTN	AUC	ALL	
SI Dif	-0.042	-0.043	-0.036	-0.039	-0.028	-0.036	-0.030	-0.036
IVT Dif	-0.045	-0.074	-0.053	-0.058	-0.067	-0.070	-0.068	-0.060
Fare Dif	-0.411	-0.368	-0.328	-0.355	-0.427	-0.221	-0.374	-0.366
Stop Qual Dif	-0.900	-0.861	-0.879	-0.875	-1.200	-1.286	-1.216	-0.958
Veh Qual	-1.068	-1.113	-0.985	-1.037	-1.625	-1.112	-1.484	-1.142
Concession Fare Constant	-0.308	-0.440	-0.447	-0.447	0.093	-0.520	-0.814	-0.879
Constant	-0.382	-0.442	-0.364	-0.390	-0.031	-0.621	-0.171	-0.303
|t| Values	CHC	WTN	AUC	ALL	WTN	AUC	ALL	ALL
SI Dif	21.0	21.5	36.0	39.0	14.0	12.0	15.0	36.0
IVT Dif	9.0	18.5	17.7	29.0	13.4	8.8	17.0	30.0
Fare Dif	13.3	16.0	17.3	27.3	17.1	4.7	17.0	33.3
Stop Quality Dif	10.2	12.9	16.0	23.0	16.2	10.1	19.0	29.0
Veh Quality Dif	8.0	10.6	11.6	17.6	13.5	5.6	14.5	22.4
Concession Fare Constant	3.0	3.3	7.0	8.9	0.1	5.7	11.0	14.4
Constant	3.8	5.7	5.6	8.7	0.3	4.1	2.3	7.8
Observations	5,941	9,478	14,060	29,479	7,672	2,714	10,386	39,865
Interviews	759	1,197	1,765	3,721	1,002	343	1,345	5,057
Relative Valuations	CHC	WTN	AUC	ALL	WTN	AUC	ALL	ALL
Service Interval / IVT (mins)	0.93	0.58	0.68	0.67	0.42	0.51	0.44	0.60
Stop Quality / IVT (mins)	20	12	17	15	18	18	18	16
Vehicle Quality / IVT (mins)	24	15	19	18	24	16	22	19
Value of Onboard Time $/hr	6.57	12.07	9.70	9.80	9.41	19.00	10.91	9.84
Stop Quality $/trip	2.19	2.34	2.68	2.46	2.81	5.82	3.25	2.62
Vehicle Quality $/trip	2.60	3.02	3.00	2.92	3.81	5.03	3.97	3.12

The relative valuations are presented at the bottom of the table. The relative valuations are graphed in figure 7.13 with their 95% confidence range (± 1.96xSTE).[69]

[68] At the extreme, repeat observations increase the sample size from 5,356 to 39,865, Given that the sampling error reduces with the square root of the sample size, the error would reduce from 73 to 200, a factor of 2.7 (approximately √8 the number of choices per interview). Douglas Economics (2004b) assessed repeat observation in a system-wide value of time study for Sydney rail undertaken in 2004 and found that a sample of 12,306 observations from 1,546 interviews could be considered the same as a survey of 12,306 respondents with one response per interview. There was therefore no reason to adjust the results.

[69] The formulas used to calculate the confidence interval are provided in appendix N (see part 2 of this report).

Figure 7.13 Relative valuations – basic model



The overall value of onboard time was $9.84/hour which was 5% lower than the $10.37 aggregate analysis estimate where no adjustment was made for concession fares. At $19/hour, the Auckland rail estimate was double the overall average but needs to be treated with caution given the high sampling error which ranged from $10 to $27/hour.

The lowest value of time was $6.57/hour for Christchurch bus. Wellington bus had the second highest value of time of $12.07/hour with Auckland bus users having a value of time of $9.70/hour which was close to the overall bus value of time of $9.80/hour.

Wellington rail users had a value of time of $9.41/hour which was three-quarters of the Wellington bus value. Including the Auckland rail users raised the average rail value of time to $10.91/hour which was 10% higher than the overall bus value.

The overall value of service interval was 0.6 which is nearly identical to the aggregate value of 0.61 in table 7.6. The value of service interval was higher for bus at 0.67 than for rail at 0.43 reflecting the shorter bus service intervals both in the SP designs and also as experienced by passengers. The value of service interval was noticeably higher for Christchurch at 0.93 although there was a wider range on this estimate.

The value of stop quality measured from very poor to very good was equivalent to 16 minutes of onboard time or $2.62 per trip. The value ranged from 12 minutes for Wellington bus to 20 minutes for Christchurch bus. Auckland rail had the highest fare valuation of $5.82 per trip and Christchurch the lowest at $2.19 per trip. The Auckland rail valuation should be treated with caution give the wide range.

The value of vehicle quality was just under a fifth higher than the stop quality. Measured from very poor to very good, the value was equivalent to 19 minutes of onboard time or $3.12 per trip. The IVT value ranged from 15 minutes for Wellington bus to 14 minutes for Christchurch bus and Wellington rail. Auckland rail had the highest fare valuation of $5.03 per trip (but with a wide range) and Christchurch the lowest at $2.62 per trip.

It should be remembered that the quality values are ‘extremes’ from very poor to very good. The observed range in vehicle quality across the bus and train routes surveyed was much narrower ranging from 63% to 83% (table 5.5). This difference would be valued at 2.8 minutes of onboard time or 45 cents of fare which in both cases is about 10% of the average onboard travel time or average fare paid.

7.9 Time period

Onboard time was valued the highest during the evening (after 7pm) at $12.57/hour. Otherwise there was little difference between the three weekday time periods. There were also only slight differences in the weekday and weekend values.

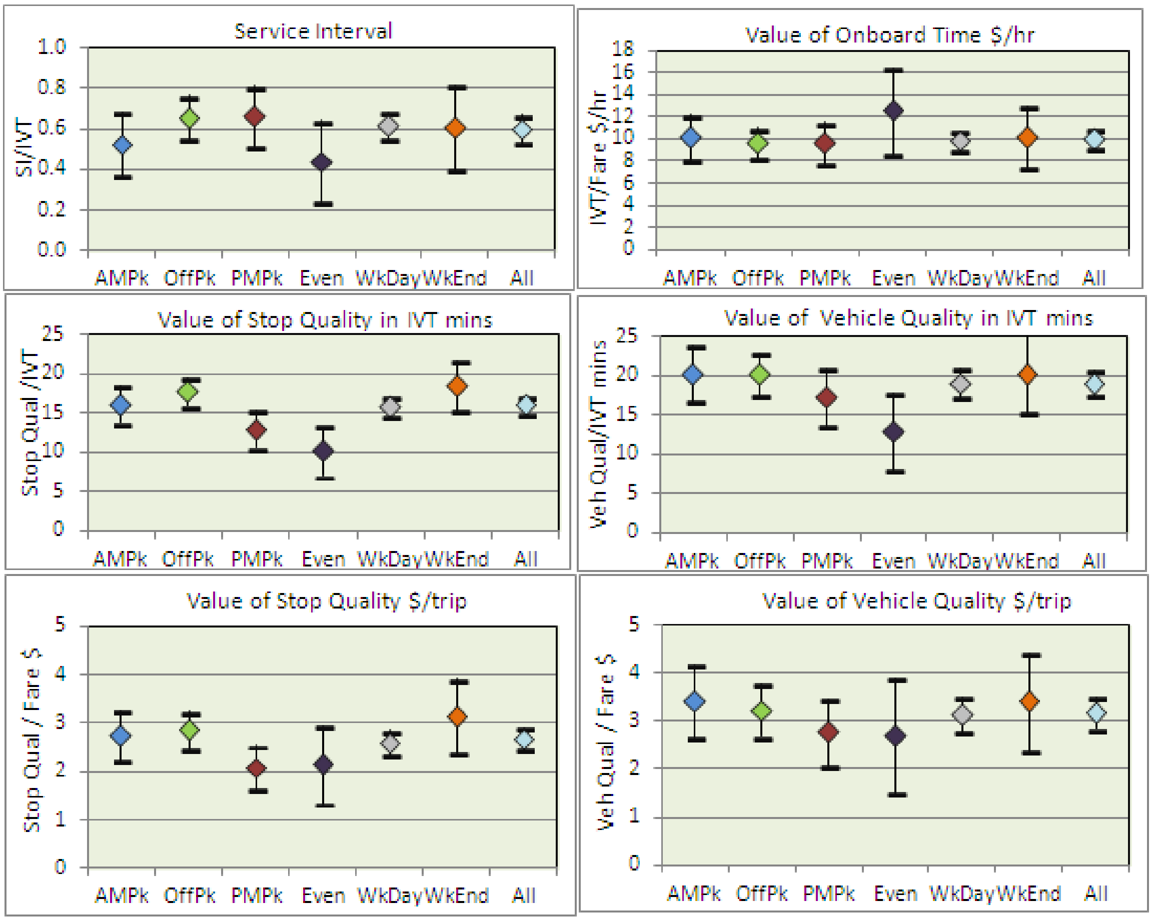
Table 7.9 Stated preference models by time period

Parameter Estimates	AMPk	OffPk	PMPk	Even	WkDay	WkEnd	All
SI Dif	-0.033	-0.036	-0.043	-0.037	-0.037	-0.034	-0.036
IVT Dif	-0.063	-0.055	-0.065	-0.084	-0.060	-0.056	-0.060
Fare Dif	-0.373	-0.344	-0.406	-0.401	-0.365	-0.331	-0.360
Stop Qual Dif	-1.015	-0.977	-0.842	-0.852	-0.946	-1.037	-0.959
Veh Qual	-1.276	-1.112	-1.124	-1.084	-1.146	-1.129	-1.143
Concession Fare Constant	-0.714	-0.521	-0.541	-0.238	-0.582	-0.311	-0.539
Constant	-0.183	-0.402	-0.243	-0.459	-0.324	-0.338	-0.326
|t| Values	AMPk	OffPk	PMPk	Even	WkDay	WkEnd	All
SI Dif	16.5	36.0	21.5	12.3	37.0	17.0	36.0
IVT Dif	12.6	18.3	13.0	9.3	30.0	9.3	30.0
Fare Dif	14.9	20.2	15.0	8.5	30.4	11.0	32.7
Stop Quality Dif	13.7	19.5	10.8	6.4	27.0	11.5	29.1
Veh Quality Dif	11.0	14.4	9.1	5.1	20.8	8.1	22.4
Concession Fare Constant	7.7	8.8	4.6	0.9	12.9	3.0	13.1
Constant	2.1	6.9	2.6	2.9	7.9	3.2	8.6
Observations	7,688	17,544	6,925	2,367	34,524	5,341	39,865
Interviews	973	2,221	877	300	4,370	676	5,046
Relative Valuations	AMPk	OffPk	PMPk	Even	WkDay	WkEnd	All
Service Interval / IVT (mins)	0.52	0.65	0.66	0.44	0.62	0.61	0.60
Stop Quality / IVT (mins)	16	18	13	10	16	19	16
Vehicle Quality / IVT (mins)	20	20	17	13	19	20	19
Value of Onboard Time $/hr	10.13	9.59	9.61	12.57	9.86	10.15	10.00
Stop Quality $/trip	2.72	2.84	2.07	2.12	2.59	3.13	2.66
Vehicle Quality $/trip	3.42	3.23	2.77	2.70	3.14	3.41	3.18

The relative valuation of service interval was also reasonably constant varying from 0.44 in the evening to 0.65/0.66 in the off-peak and PM peak.

Stop and vehicle quality were valued higher at the weekend. During weekdays, the value of stop quality was highest in the off peak and lowest in the PM peak whereas vehicle quality was valued highest in the AM peak and lowest in the evening.

Figure 7.14 Relative valuations by time period



7.10 Trip length

Passengers making longer trips of over an hour (onboard time) responded differently to passengers making shorter trips. The sensitivity to onboard time and to service interval was lower whereas that for quality, particularly vehicle quality, was higher. Consequently, the valuations of service interval and travel time were lower but vehicle quality was valued more highly.

The only consistent effect across all the market segments was for the sensitivity to vehicle quality to increase with trip length. For short trips of up to 15 minutes (with an average IVT of nine minutes), the sensitivity to vehicle quality was at its lowest. Sensitivity then increased with trip length. [70]

[70] Appendix P which standardises the vehicle quality parameter for trip length provides a graph of the vehicle quality parameter against IVT and shows the relationship to be approximately linear.

Table 7.10 Stated preference models by trip length

Parameter Estimates	Trip Length (In-vehicle time minutes) <15	15-29	30-44	45-59	60+	All
SI Dif	-0.037	-0.039	-0.039	-0.040	-0.019	-0.036
IVT Dif	-0.053	-0.065	-0.069	-0.063	-0.041	-0.060
Fare Dif	-0.273	-0.393	-0.402	-0.394	-0.346	-0.360
Stop Qual Dif	-0.868	-1.005	-0.970	-0.894	-1.091	-0.959
Veh Qual DIF	-0.843	-1.096	-1.130	-1.514	-1.790	-1.143
Concession Fare Constant	-0.201	-0.659	-0.392	-0.976	-0.678	-0.539
Constant	-0.398	-0.321	-0.411	-0.262	0.011	-0.326
|t| Values	<15	15-29	30-44	45-59	60+	All
SI Dif	18.5	39.0	19.5	13.3	6.3	36.0
IVT Dif	10.6	21.7	13.8	9.0	5.9	30.0
Fare Dif	10.5	21.8	15.5	10.6	8.9	32.7
Stop Quality Dif	11.3	19.3	13.1	8.4	9.2	29.1
Veh Quality Dif	7.0	13.5	9.7	9.0	9.4	22.4
Concession Fare Constant	2.0	9.6	4.7	7.6	4.2	13.1
Constant	4.4	5.4	4.7	2.1	0.1	8.6
Observations	9,121	16,229	7,778	3,761	2,976	39,865
Interviews	1,155	2,054	985	476	377	5,046
Relative Valuations	<15	15-29	30-44	45-59	60+	All
Av IVT mins	9	19.5	33.6	48.3	66	27
Service Interval / IVT (mins)	0.70	0.60	0.57	0.63	0.46	0.60
Stop Quality / IVT (mins)	16	15	14	14	27	16
Vehicle Quality / IVT (mins)	16	17	16	24	44	19
Value of Onboard Time $/hr	11.65	9.92	10.30	9.59	7.11	10.00
Stop Quality $/trip	3.18	2.56	2.41	2.27	3.15	2.66
Vehicle Quality $/trip	3.09	2.79	2.81	3.84	5.17	3.18

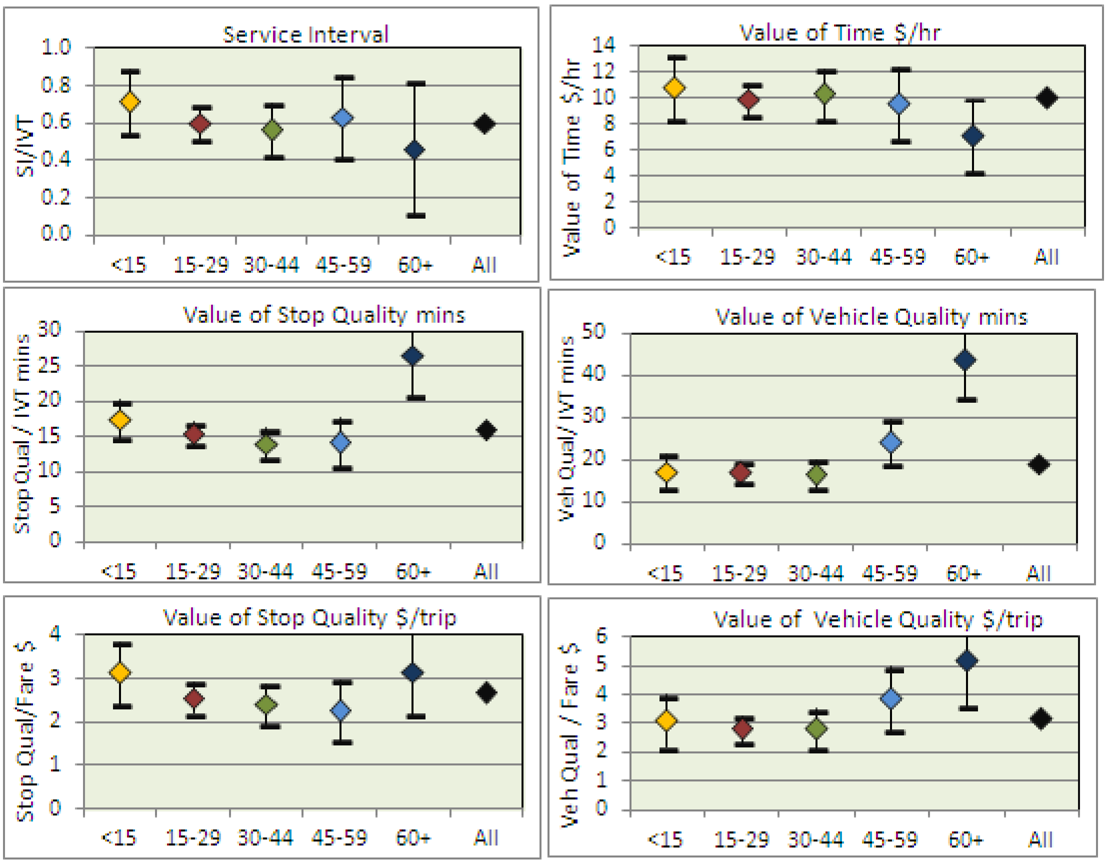
The valuation of service interval declined consistently with trip length.

The value of time was highest for short trips at $10.81/hour and lowest at $7.11/hour for long trips. This was largely to a decline in the sensitivity to travel time rather than an increase in the sensitivity to fare. However between 15 minutes and an hour there was no consistent trend in the value of IVT.

The value of vehicle quality was reasonably constant at 16 minutes for trips up to 45 minutes then increased to 24 minutes for trips of 45–60 minutes and to 44 minutes for trips over an hour. The fare valuation of vehicle quality was around $3 for trips up to 45 minutes and over $5 for trips over an hour.

The value of stop quality was reasonably constant at around 15 minutes for trips under an hour but doubled to 27 minutes for trips over an hour. The fare valuation was around $4 per trip.

Figure 7.15 Relative valuations by trip length



7.11 Service interval

The observations were categorised into five classes depending on how frequent the respondent perceived their services to be (see section 4.3). Table 7.11 presents the fitted models.

The service interval parameter (SI Dif) declined strongly as the perceived service interval increased. The sensitivity to IVT also declined as the service interval increased but much more gradually.

The combined effect of the IVT and service interval parameters was that respondents who had frequent services (every 15 minutes) valued a minute of service interval equivalent to 0.73 minutes of IVT. The valuation then steadily declined to 0.45 for passengers with half-hourly services and to 0.25 for passengers with hourly or less frequent services.

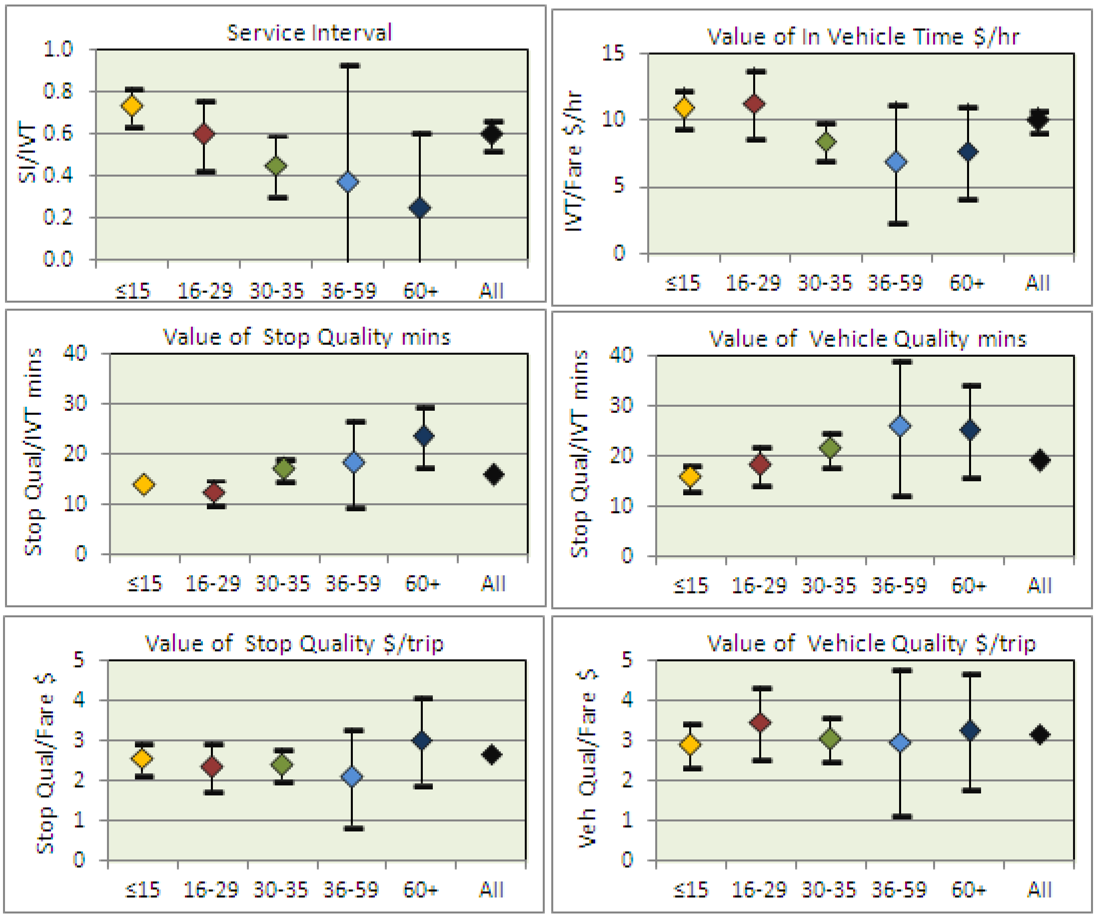
There was an expectation that the sensitivity to stop quality would increase for less frequent services (since respondents spend more time at the bus stop or train station and should attach a greater importance to quality) although this was not supported by response. The increase value of stop quality measured in IVT was attributable to a declining sensitivity to IVT. When expressed in terms of fare, the valuation of stop quality was roughly constant.

The sensitivity to vehicle quality and also to fare was also unrelated to the service interval.

Table 7.11 Stated preference models by perceived service interval

Parameter Estimates	≤15	16-29	30-35	36-59	60+	All
SI Dif	-0.049	-0.042	-0.025	-0.017	-0.013	-0.036
IVT Dif	-0.067	-0.070	-0.055	-0.046	-0.052	-0.060
Fare Dif	-0.367	-0.372	-0.389	-0.401	-0.406	-0.360
Stop Qual Dif	-0.944	-0.878	-0.937	-0.839	-1.229	-0.959
Veh Qual	-1.068	-1.288	-1.182	-1.191	-1.315	-1.143
Concession Fare Constant	-0.525	-0.554	-0.427	-0.389	-0.864	-0.539
Constant	-0.373	-0.348	-0.255	-0.141	-0.139	-0.326
|t| Values	≤15	16-29	30-35	36-59	60+	All
SI Dif	49.0	21.0	25.0	3.4	3.3	36.0
IVT Dif	22.3	11.7	13.8	3.5	5.2	30.0
Fare Dif	19.3	12.4	19.5	5.8	7.7	32.7
Stop Quality Dif	17.2	10.1	16.2	4.2	7.7	29.1
Veh Quality Dif	12.4	9.5	12.8	3.8	5.4	22.4
Concession Fare Constant	7.7	4.8	5.2	1.7	5.2	13.1
Constant	5.8	3.4	3.7	0.6	0.8	8.6
Observations	14,419	5,661	12,158	1,019	1,773	39,865
Interviews	1,825	717	1,539	129	224	5,046
Relative Valuations	≤15	16-29	30-35	36-59	60+	All
Av Service Interval (mins)	12.5	21	30	43	62	23
Service Interval / IVT (mins)	0.73	0.60	0.45	0.37	0.25	0.60
Stop Quality / IVT (mins)	14	13	17	18	24	16
Vehicle Quality / IVT (mins)	16	18	21	26	25	19
Value of Onboard Time $/hr	10.95	11.29	8.48	6.88	7.68	10.00
Stop Quality $/trip	2.57	2.36	2.41	2.09	3.03	2.66
Vehicle Quality $/trip	2.91	3.46	3.04	2.97	3.24	3.18

Figure 7.16 Relative valuations by service interval



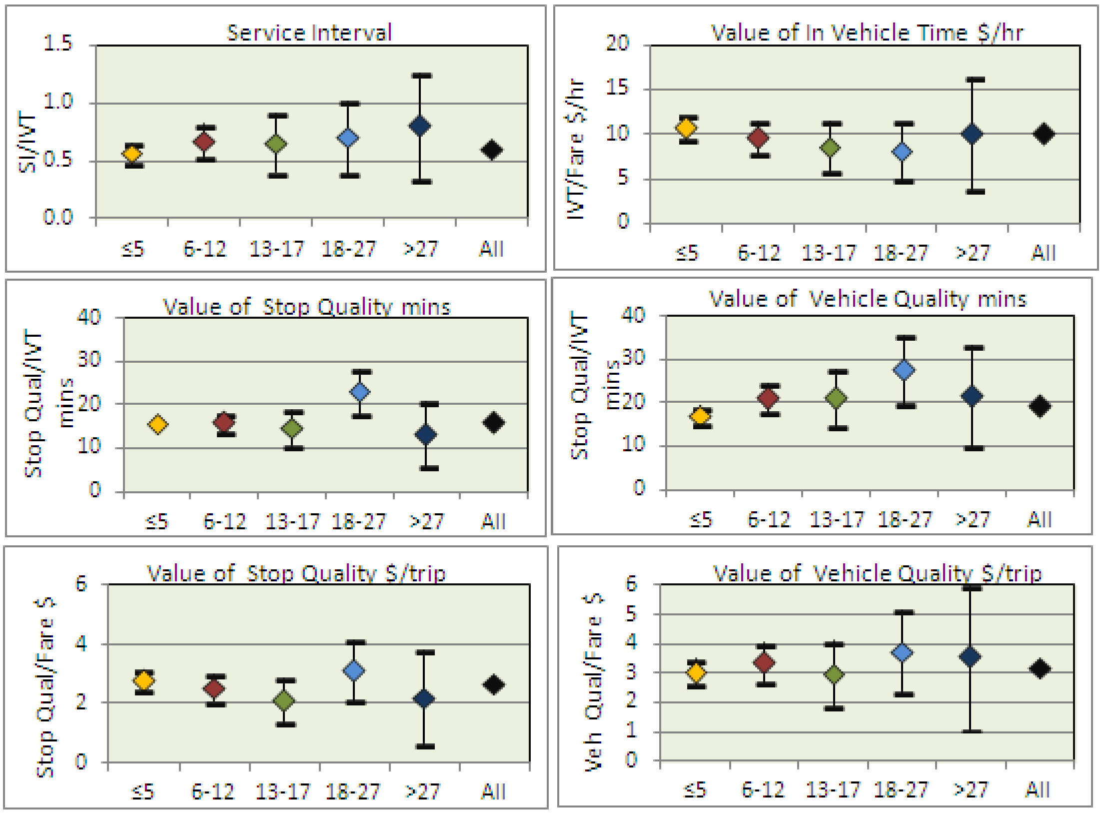
7.12 Wait time

The observations were split into five categories depending on how long the respondents had waited for their service (see section 5.3). Table 7.12 presents the parameter estimates and figure 7.17 graphs the relative valuations. As can be seen, the valuation of service interval was largely invariant with wait time.

Table 7.12 Stated preference models by perceived wait time

Parameter Estimates	≤5	6-12	13-17	18-27	>27	All
SI Dif	-0.037	-0.037	-0.036	-0.036	-0.035	-0.036
IVT Dif	-0.066	-0.055	-0.055	-0.051	-0.044	-0.060
Fare Dif	-0.371	-0.346	-0.387	-0.378	-0.264	-0.360
Stop Qual Dif	-1.030	-0.873	-0.809	-1.175	-0.580	-0.959
Veh Qual Dif	-1.121	-1.157	-1.153	-1.407	-0.942	-1.143
Concession Fare Constant	-0.642	-0.392	-0.724	-0.252	-0.352	-0.539
Constant	-0.300	-0.340	-0.272	-0.442	-0.524	-0.326
|t| Values	≤5	6-12	13-17	18-27	>27	All
SI Dif	37.0	37.0	12.0	12.0	8.8	36.0
IVT Dif	22.0	13.8	7.9	6.4	4.4	30.0
Fare Dif	24.7	16.5	9.4	8.0	4.5	32.7
Stop Quality Dif	22.9	14.6	7.0	8.8	3.5	29.1
Veh Quality Dif	16.0	12.3	6.3	6.8	3.6	22.4
Concession Fare Constant	10.2	5.2	5.4	1.9	2.2	13.1
Constant	5.8	4.8	2.0	2.8	2.6	8.6
Observations	21,315	11,480	2,891	2,485	1,461	39,865
Interviews	2,698	1,453	366	315	185	5,046
Relative Valuations	≤5	6-12	13-17	18-27	>27	All
Av Wait mins	3	9	15	21	36	8
Service Interval / IVT (mins)	0.56	0.67	0.65	0.71	0.80	0.60
Stop Quality / IVT (mins)	16	16	15	23	13	16
Vehicle Quality / IVT (mins)	17	21	21	28	21	19
Value of Onboard Time $/hr	10.67	9.54	8.53	8.10	10.00	10.00
Stop Quality $/trip	2.78	2.52	2.09	3.11	2.20	2.66
Vehicle Quality $/trip	3.02	3.34	2.98	3.72	3.57	3.18

Figure 7.17 Relative valuations by perceived wait time



7.13 Fare paid

The sample included 145 respondents travelling free, most of whom (93%) were over 64 years of age and using a SuperGold Card.

The sensitivity to fare was lower for 'free' passengers but not by as much as sensitivity to onboard travel time. The result was a value of time for 'free' passengers, which was 56% that of paying passengers ($5.59/hour).

Free passengers also had a lower sensitivity to service interval but again the reduction was less than for IVT and as a result, the valuation of service interval at 1.23 was double the overall value of 0.6.

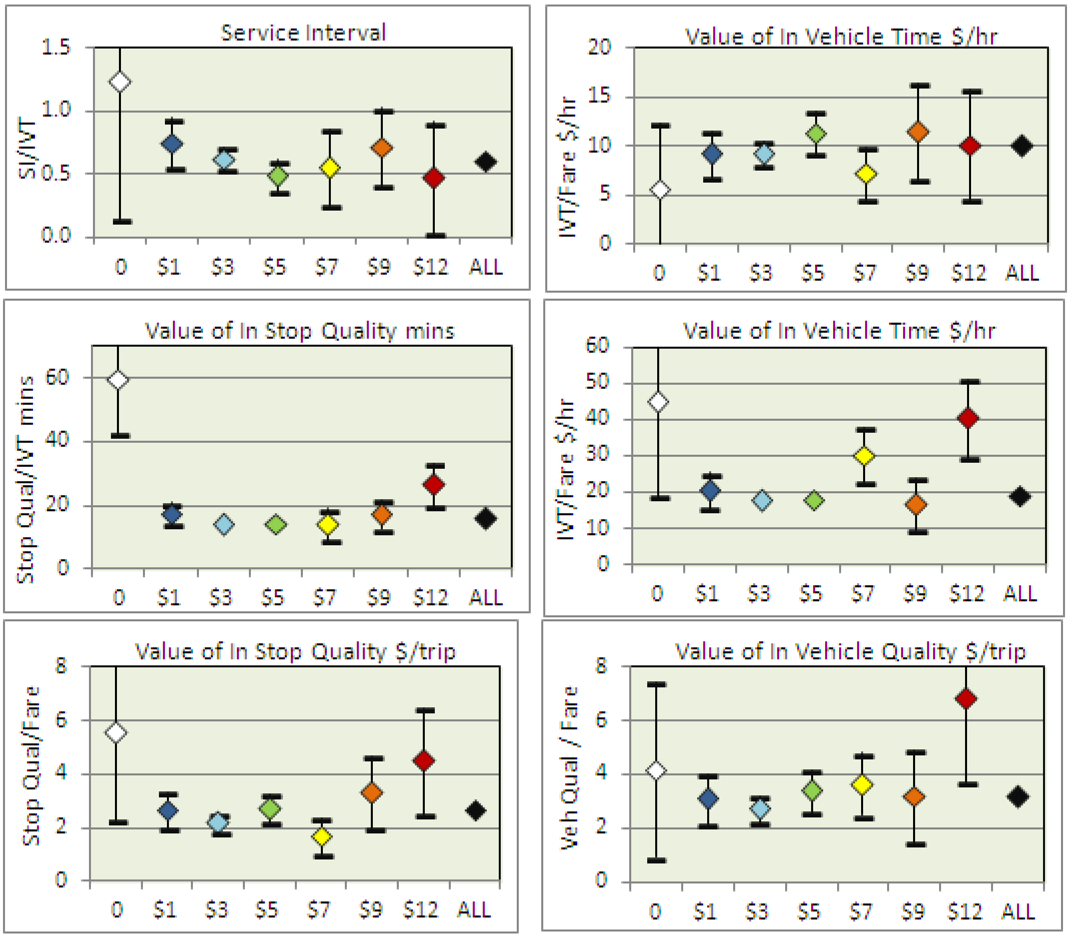
Similarly, the valuation of stop and vehicle quality was higher than for fare-paying passengers.

For fare-paying passengers there was no strong relationship with fare paid. The only exception was for passengers paying over $10 per trip to have higher stop and vehicle valuations. As over one half of these respondents were using the Wellington Airport Express (which provides a premium service quality) some conditioning of response was evident.

Table 7.13 Stated preference models by fare paid

Parameter Estimates	Free	<$2	$2-$4	$4-$6	$6-$8	$8-$10	≥$10	All
SI Dif	-0.027	-0.038	-0.039	-0.036	-0.028	-0.047	-0.022	-0.036
IVT Dif	-0.022	-0.051	-0.063	-0.075	-0.051	-0.066	-0.047	-0.060
Fare Dif	-0.236	-0.335	-0.411	-0.396	-0.423	-0.345	-0.278	-0.360
Stop Qual Dif	-1.312	-0.889	-0.887	-1.071	-0.715	-1.136	-1.246	-0.959
Veh Qual	-0.986	-1.033	-1.112	-1.340	-1.537	-1.102	-1.890	-1.143
Concession Fare Constant	na	-0.378	-0.320	-0.645	-0.337	-0.644	-0.805	-0.539
Constant	0.055	-0.471	-0.436	-0.391	0.019	0.038	-0.082	-0.326
|t| Values	Free	<$2	$2-$4	$4-$6	$6-$8	$8-$10	≥$10	All
SI Dif	6.8	19.0	39.0	18.0	9.3	11.8	5.5	36.0
IVT Dif	1.8	10.2	21.0	15.0	6.4	6.6	4.7	30.0
Fare Dif	3.8	11.2	21.6	14.7	10.1	6.4	5.5	32.7
Stop Quality Dif	6.9	10.5	16.1	13.4	5.7	7.3	7.7	29.1
Veh Quality Dif	3.3	7.8	13.1	10.7	7.8	4.5	7.2	22.4
Concession Fare Constant	na	4.7	5.0	6.3	1.6	0.8	1.5	13.1
Constant	0.2	4.7	6.8	4.2	0.1	0.2	0.4	8.6
Observations	1,143	5,975	14,628	6,883	2,656	1,746	1,661	39,865
Interviews	145	756	1,852	871	336	221	210	5,046
Relative Valuations	Free	<$2	$2-$4	$4-$6	$6-$8	$8-$10	≥$10	All
Av Fare $/trip	0	$1	$3	$5	$7	$9	$12	ALL
Service Interval / IVT (mins)	1.23	0.75	0.62	0.48	0.55	0.71	0.47	0.60
Stop Quality / IVT (mins)	60	17	14	14	14	17	27	16
Vehicle Quality / IVT (mins)	45	20	18	18	30	17	40	19
Value of Onboard Time $/hr	5.59	9.13	9.20	11.36	7.23	11.48	10.14	10.00
Stop Quality $/trip	5.56	2.65	2.16	2.70	1.69	3.29	4.48	2.66
Vehicle Quality $/trip	4.18	3.08	2.71	3.38	3.63	3.19	6.80	3.18

Figure 7.18 Relative valuations by fare paid



7.14 Journey purpose

The fare, travel time and quality parameters for the eight journey purpose segmentations were statistically significant, reflecting the large sample sizes. There was one exception – the vehicle quality parameter for company business trips – although for this segment the sample size was smallest (550 observations).

At $24.19/hour, company business trips had a noticeably higher value of time when compared with the other trip purposes which ranged from $8.17/hour for visiting friends and relatives to $12.23/hour for personal business trips. Commuters to/from work had a value of time of $10.08/hour and 'education commuters' a value of $8.92/hour.

The value of service interval ranged from 0.27 for company business trips to 0.8 for VFR. The value was higher for 'other' trips which included passengers making long-distance air, ferry or rail trips. For work-commuting and education trips, service interval was valued at 0.57 and 0.67 respectively. Given their large sample sizes, these two values largely determined the overall valuation of 0.6.

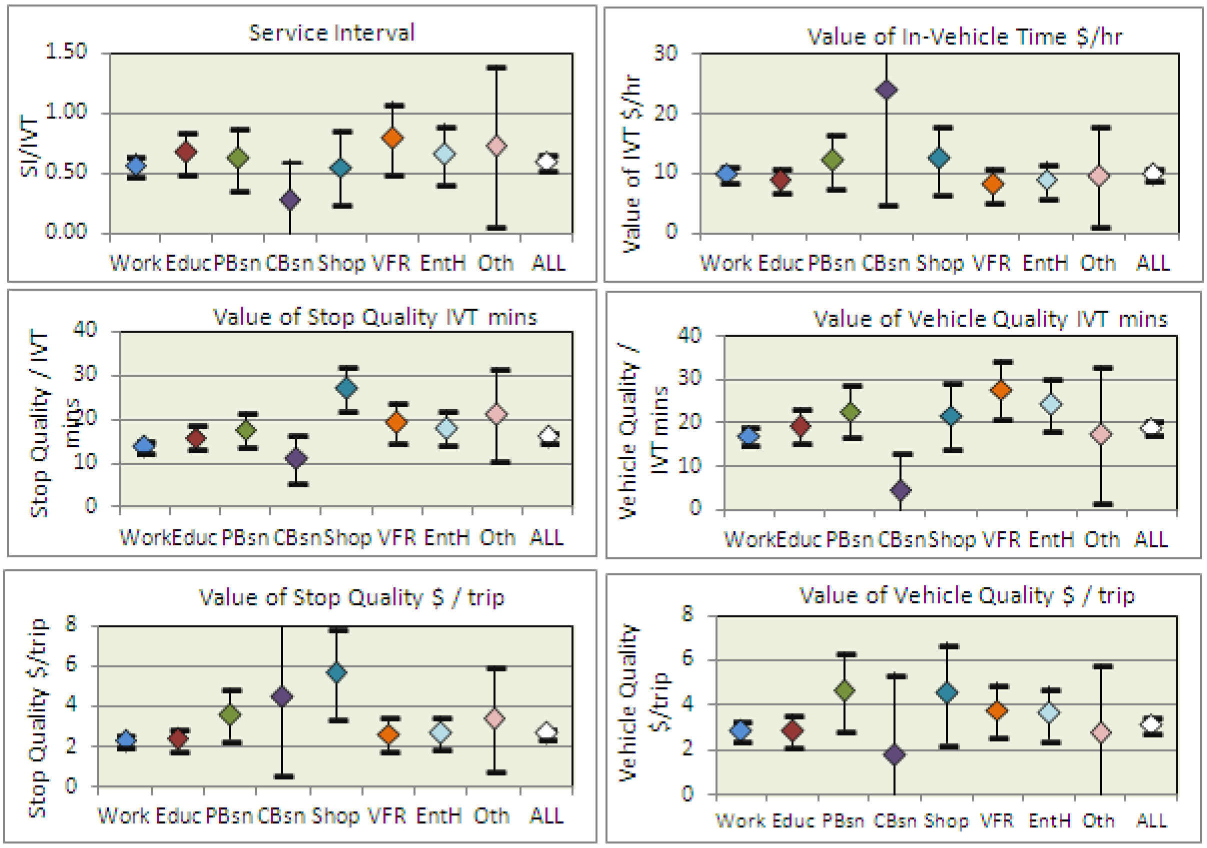
Work commuters and company business trips tended to value stop quality lower. Commuters valued stop quality at 14 minutes compared with shoppers at 27 minutes. When translated into dollars per trip, commuters were willing to pay $2.31 per trip compared with $5.63 per trip by shoppers.

Vehicle quality was generally valued higher per trip than stop quality but there were three trip purposes where vehicle quality was valued lower: shopping, company business and 'other' trips.

Table 7.14 Journey purpose stated preference models

Parameter Estimates	Work	Educ	PBsn	CBsn	Shop	VFR	EntH	Oth	ALL
SI Dif	-0.038	-0.039	-0.033	-0.028	-0.026	-0.039	-0.043	-0.038	-0.036
IVT Dif	-0.067	-0.058	-0.053	-0.102	-0.047	-0.049	-0.065	-0.052	-0.060
Fare Dif	-0.399	-0.390	-0.260	-0.253	-0.226	-0.360	-0.432	-0.323	-0.360
Stop Qual Dif	-0.921	-0.926	-0.937	-1.127	-1.273	-0.950	-1.170	-1.096	-0.959
Veh Qual	-1.143	-1.122	-1.206	-0.451	-1.023	-1.360	-1.571	-0.899	-1.143
Concession Fare Constant	-0.777	-0.297	-0.227	na	-0.407	-0.388	-0.597	0.134	-0.539
Constant	-0.171	-0.535	0.661	-0.226	-0.467	-0.348	-0.212	-0.464	-0.326
|t| Values	Work	Educ	PBsn	CBsn	Shop	VFR	EntH	Oth	ALL
SI Dif	38.0	19.5	16.5	4.0	8.7	13.0	14.3	5.4	36.0
IVT Dif	22.3	11.6	7.6	5.7	6.7	7.0	8.1	3.1	30.0
Fare Dif	23.5	13.9	7.4	2.8	5.7	9.7	9.8	3.4	32.7
Stop Quality Dif	18.8	11.9	8.9	4.1	10.7	8.6	9.0	3.9	29.1
Veh Quality Dif	14.8	9.4	7.4	1.0	5.6	8.0	7.8	2.1	22.4
Concession Fare Constant	6.0	4.6	1.6	na	2.9	3.1	3.9	0.4	13.1
Constant	2.9	5.8	5.4	0.7	3.4	2.8	1.4	1.5	8.6
Observations	17,511	7,376	3,879	550	3,105	3,679	2,705	2,705	39,877
Interviews	2,217	934	491	70	393	466	342	342	5,048
Relative Valuations	Work	Educ	PBsn	CBsn	Shop	VFR	EntH	Oth	ALL
Service Interval / IVT (mins)	0.57	0.67	0.62	0.27	0.55	0.80	0.66	0.73	0.60
Stop Quality / IVT (mins)	14	16	18	11	27	19	18	21	16
Vehicle Quality / IVT (mins)	17	19	23	4	22	28	24	17	19
Value of Onboard Time $/hr	10.08	8.92	12.23	24.19	12.48	8.17	9.03	9.66	10.00
Stop Quality $/trip	2.31	2.37	3.60	4.45	5.63	2.64	2.71	3.39	2.66
Vehicle Quality $/trip	2.86	2.88	4.64	1.78	4.53	3.78	3.64	2.78	3.18

Figure 7.19 Relative valuations – journey purpose



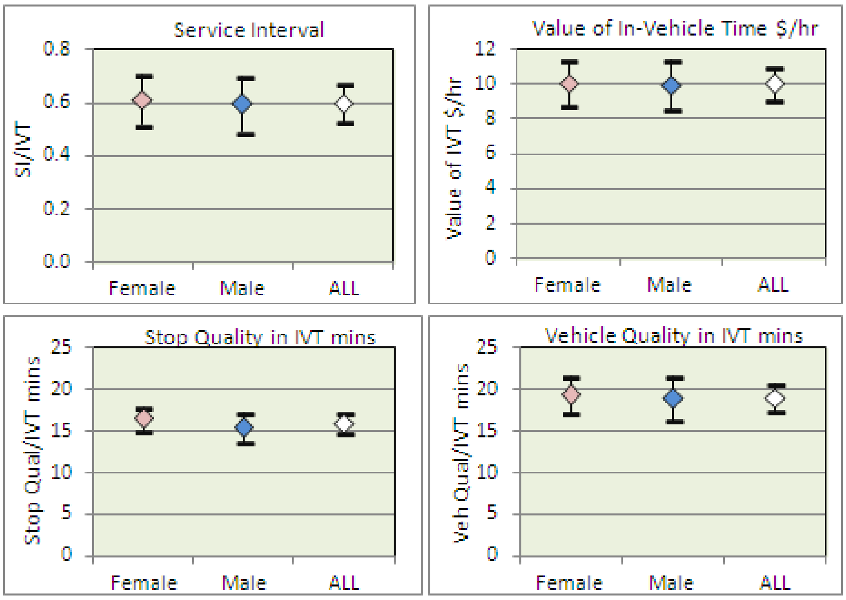
7.15 Gender

Males tended to be less sensitive than females to changes in fare, time and quality. For example, males were 10% less sensitive than females to changes in service interval. However, given that the reduced sensitivity was 'across the board', the relative valuations were similar for males and females.

Table 7.15 Gender stated preference models

Parameter Estimates	Female	Male	ALL
SI Dif	-0.038	-0.034	-0.036
IVT Dif	-0.062	-0.057	-0.060
Fare Dif	-0.370	-0.344	-0.360
Stop Qual Dif	-1.020	-0.883	-0.959
Veh Qual	-1.202	-1.076	-1.143
Concession Fare Constant	-0.608	-0.459	-0.539
Constant	-0.280	-0.399	-0.326
|t| Values	Female	Male	ALL
SI Dif	38.0	34.0	36.0
IVT Dif	20.7	19.0	30.0
Fare Dif	24.7	20.2	32.7
Stop Quality Dif	23.7	17.7	29.1
Veh Quality Dif	17.7	13.8	22.4
Concession Fare Constant	11.3	7.1	13.1
Constant	5.5	6.8	8.6
Observations	22,690	16,851	39,877
Interviews	2,872	2,133	5,048
Relative Valuations	Female	Male	ALL
Service Interval / IVT (mins)	0.61	0.60	0.60
Stop Quality / IVT (mins)	16	15	16
Vehicle Quality / IVT (mins)	19	19	19
Value of Onboard Time $/hr	10.05	9.94	10.00
Stop Quality $/trip	2.76	2.57	2.66
Vehicle Quality $/trip	3.25	3.13	3.18

Figure 7.20 Relative valuations – gender



7.16 Socio-economic status

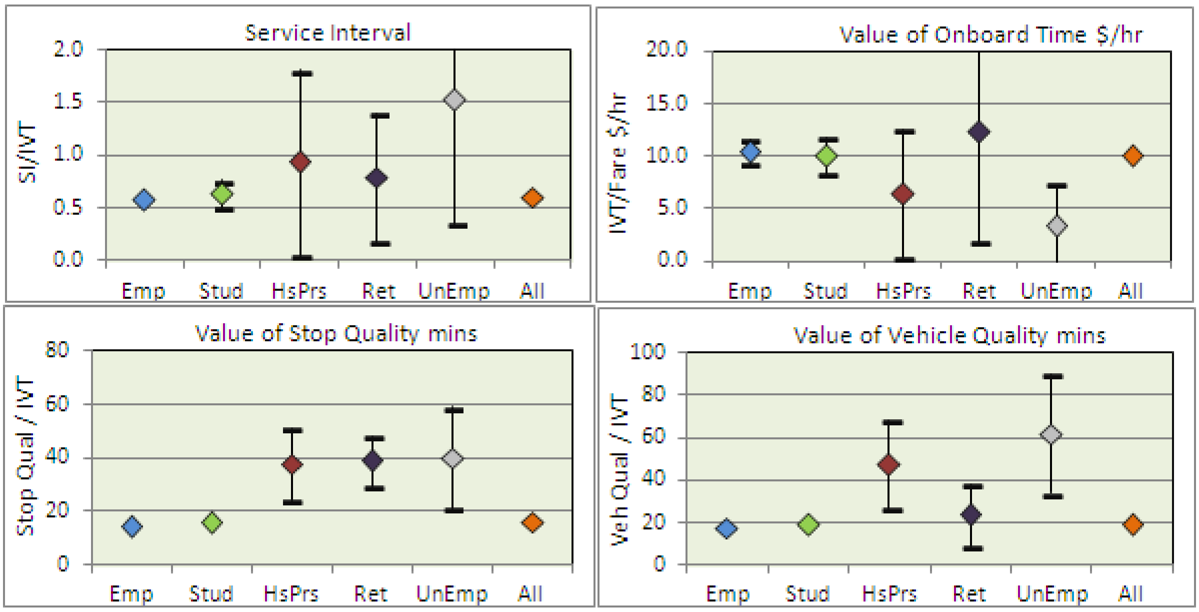
There was little difference between the values for student and employed passengers but house persons, retired and unemployed were only half as sensitive to travel time which fed through to higher stop and vehicle quality valuations.

Retired passengers were also less sensitive to fare which partly reflected the free travel for SuperGold Card holders. As a consequence, the stop and station quality fare valuations of retired passengers were also higher.

Table 7.16 Socio-economic status stated preference models

Parameter Estimates	Emp	Stud	HsPrs	Ret	UnEmp	All
SI Dif	-0.039	-0.038	-0.026	-0.027	-0.029	-0.036
IVT Dif	-0.068	-0.060	-0.028	-0.034	-0.019	-0.060
Fare Dif	-0.391	-0.360	-0.263	-0.166	-0.342	-0.360
Stop Qual Dif	-0.972	-0.953	-1.056	-1.317	-0.761	-0.959
Veh Qual	-1.188	-1.126	-1.327	-0.800	-1.177	-1.143
Concession Fare Constant	-0.806	-0.224	-0.041	na	-0.516	-0.539
Constant	-0.191	-0.619	-0.485	-0.229	-0.380	-0.326
|t| Values	Emp	Stud	HsPrs	Ret	UnEmp	All
SI Dif	39.0	38.0	5.2	6.8	7.3	36.0
IVT Dif	22.7	15.0	2.3	3.4	1.7	30.0
Fare Dif	26.1	17.1	4.2	3.1	6.0	32.7
Stop Quality Dif	22.6	16.2	5.5	8.0	4.2	29.1
Veh Quality Dif	17.5	12.4	4.5	3.1	4.3	22.4
Concession Fare Constant	7.0	4.5	0.1	na	1.8	13.1
Constant	3.7	8.8	2.2	1.2	1.9	8.6
Observations	22,740	12,751	1,187	1,511	1,467	39,865
Interviews	2,878	1,614	150	191	186	5,046
Relative Valuations	Emp	Stud	HsPrs	Ret	UnEmp	All
Service Interval / IVT (mins)	0.57	0.63	0.93	0.79	1.53	0.60
Stop Quality / IVT (mins)	14	16	38	39	40	16
Vehicle Quality / IVT (mins)	17	19	47	24	62	19
Value of Onboard Time $/hr	10.43	10.00	6.39	12.29	3.33	10.00
Stop Quality $/trip	2.49	2.65	4.02	7.93	2.23	2.66
Vehicle Quality $/trip	3.04	3.13	5.05	4.82	3.44	3.18

Figure 7.21 Relative valuations – socio-economic status



7.17 Age group

The value of time was lowest amongst young respondents and highest amongst the oldest respondents. For respondents up to 17 years old, the value of time was $8.38/hour and for over 64 year olds it was $11.50/hour (which corresponds to the higher value for retired passengers discussed in the previous section).

There was a less consistent trend for service interval.

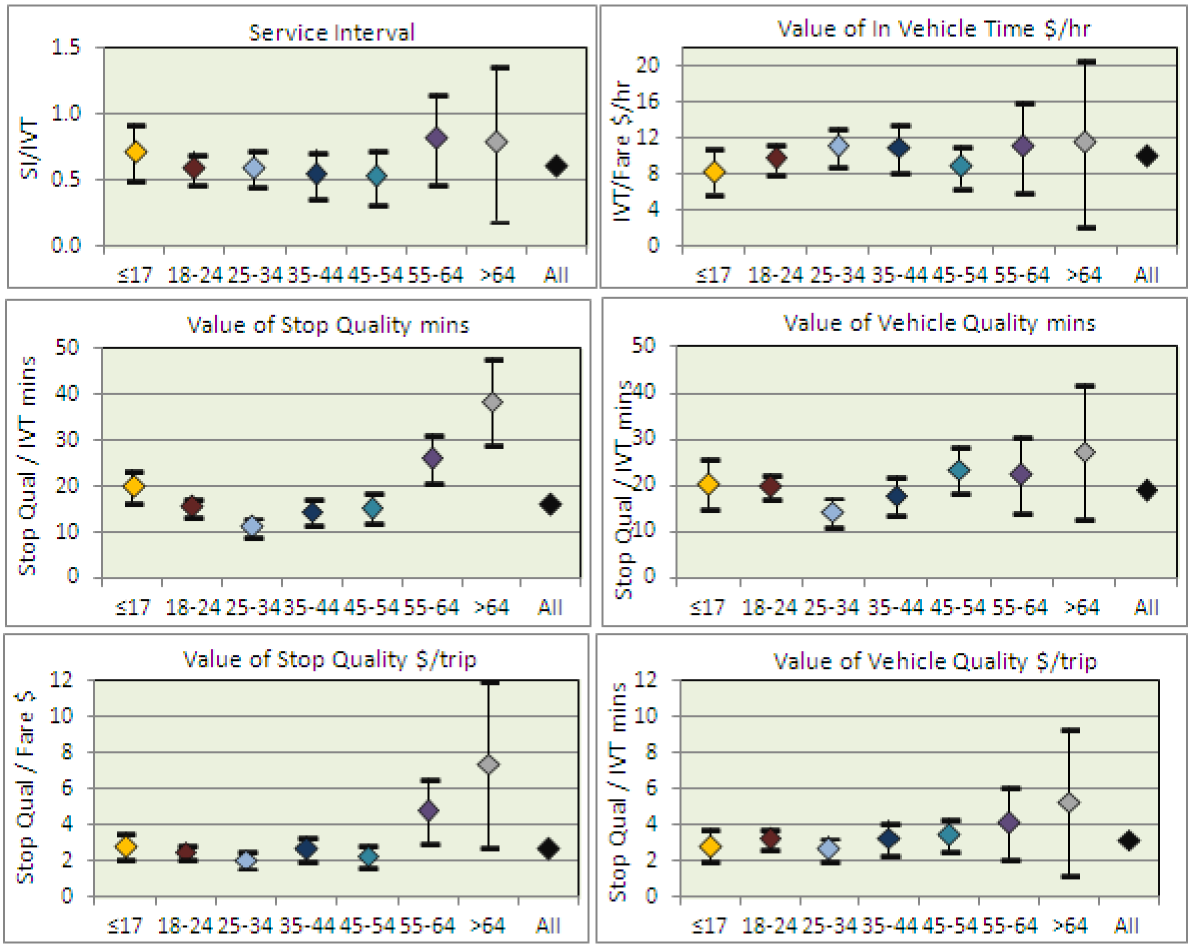
Over 64 year olds valued stop quality highest and 24–34 year olds the lowest. Expressed in terms of fare, the value of stop quality reached $7.38 per trip for over 64 year olds but was only $2.05 per trip for 25–34 year olds.

Likewise vehicle quality was valued highest by over 64 year olds at $5.26 per trip and least by 25–34 year olds at $2.64 per trip.

Table 7.17 Age group stated preference models

Parameter Estimates	≤17	18-24	25-34	35-44	45-54	55-64	>64	All
SI Dif	-0.040	-0.037	-0.042	-0.036	-0.030	-0.039	-0.025	-0.036
IVT Dif	-0.056	-0.063	-0.071	-0.066	-0.057	-0.048	-0.032	-0.060
Fare Dif	-0.401	-0.389	-0.384	-0.361	-0.385	-0.261	-0.167	-0.360
Stop Qual Dif	-1.124	-0.977	-0.788	-0.960	-0.871	-1.252	-1.233	-0.959
Veh Qual	-1.142	-1.247	-1.014	-1.181	-1.337	-1.076	-0.878	-1.143
Concession Fare Constant	-0.216	-0.323	na	na	na	na	na	-0.539
Constant	-0.535	-0.545	-0.330	0.104	-0.090	-0.030	-0.188	-0.326
|t| Values	≤17	18-24	25-34	35-44	45-54	55-64	>64	All
SI Dif	20.0	37.0	21.0	18.0	15.0	13.0	6.3	36.0
IVT Dif	9.3	15.8	14.2	11.0	9.5	6.0	3.6	30.0
Fare Dif	10.0	19.5	15.4	12.0	12.4	6.2	3.4	32.7
Stop Quality Dif	11.2	16.3	10.9	10.8	9.5	9.9	8.1	29.1
Veh Quality Dif	7.4	13.6	8.9	8.4	9.2	5.3	3.7	22.4
Concession Fare Constant	2.9	4.5	na	na	na	na	na	13.1
Constant	4.2	7.9	3.9	1.0	0.8	0.2	1.1	8.6
Observations	4,526	12,598	8,014	5,236	4,891	2,543	1,757	39,865
Interviews	573	1,595	1,014	663	619	322	222	5,046
Relative Valuations	≤17	18-24	25-34	35-44	45-54	55-64	>64	All
Service Interval / IVT (mins)	0.71	0.59	0.59	0.55	0.53	0.81	0.78	0.60
Stop Quality / IVT (mins)	20	16	11	15	15	26	39	16
Vehicle Quality / IVT (mins)	20	20	14	18	23	22	27	19
Value of Onboard Time $/hr	8.38	9.72	11.09	10.97	8.88	11.03	11.50	10.00
Stop Quality $/trip	2.80	2.51	2.05	2.66	2.26	4.80	7.38	2.66
Vehicle Quality $/trip	2.85	3.21	2.64	3.27	3.47	4.12	5.26	3.18

Figure 7.22 Relative valuations by age group



7.18 Personal income

The SP survey included a question on personal income (see section 3.7). Some passengers did not answer the income question and for these responses, a probabilistic method was used to assign income levels based on occupation.

Response showed that as income increased, the sensitivity to IVT and vehicle quality increased. However, the sensitivity to fare did not decrease as might be expected. Service interval and stop quality were largely unaffected.

Higher income reduced the size of the constant reflecting the tendency for respondents to choose the slower/cheaper option.[71]

The value of time increased from $8.90/hour for respondents with incomes less than $30,000 to $13.60/hour for incomes over $120,000.

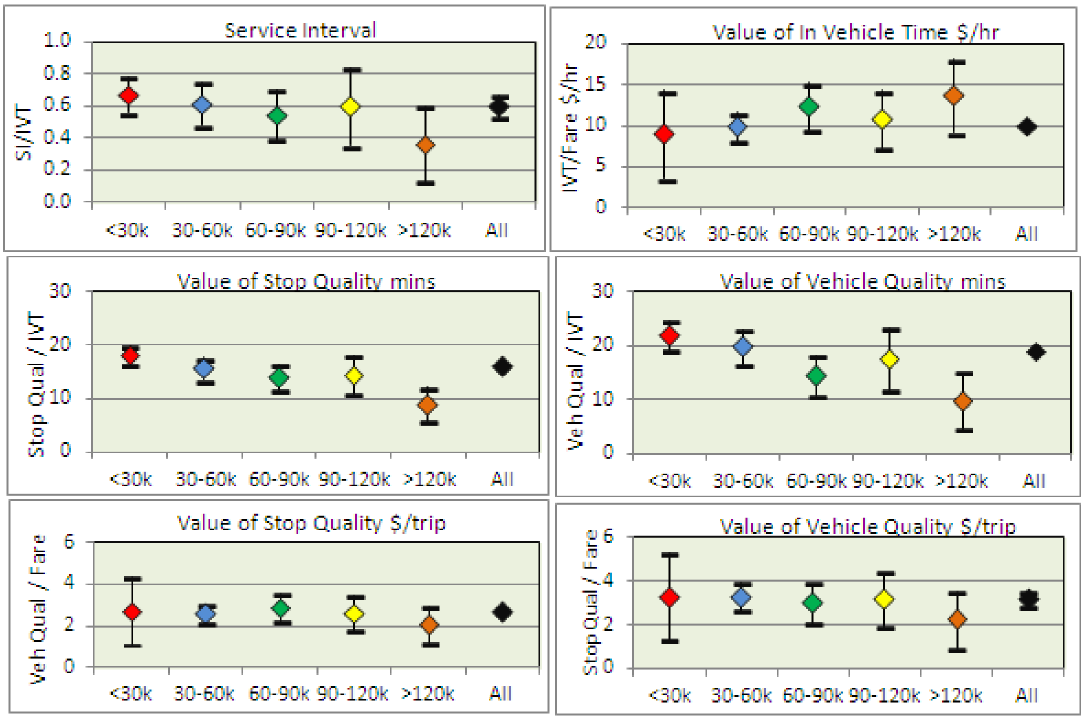
[71] For incomes above $60,000, the concession fare constant was omitted because there were too few observations. The constant also became statistically insignificant with the t value falling to 0.5 for the over $120,000 income bracket. Whereas in the <$30,000 bracket, the constant was worth around 10 minutes and had a t value of 9.5 with more respondents always choosing the cheaper/slower option.

There was a decline in the relative valuations of service interval, stop quality and vehicle quality from rising income which stemmed from the increased sensitivity to IVT. When the valuations were expressed in terms of fare, they remained reasonably constant as figure 7.23 shows.

Table 7.18 Income stated preference models

Parameter Estimates	<30k	30-60k	60-90k	90-120k	>120k	All
SI Dif	-0.035	-0.038	-0.042	-0.043	-0.036	-0.036
IVT Dif	-0.052	-0.062	-0.077	-0.072	-0.099	-0.060
Fare Dif	-0.350	-0.376	-0.374	-0.400	-0.436	-0.360
Stop Qual Dif	-0.945	-0.962	-1.073	-1.039	-0.878	-0.959
Veh Qual	-1.144	-1.231	-1.112	-1.259	-0.967	-1.143
Concession Fare Constant	-0.266	-0.693	na	na	na	-0.539
Constant	-0.511	-0.282	0.109	0.111	0.101	-0.326
|t| Values	<30k	30-60k	60-90k	90-120k	>120k	All
SI Dif	35.0	19.0	21.0	14.3	9.0	36.0
IVT Dif	17.3	15.5	12.8	8.0	9.0	30.0
Fare Dif	3.3	17.1	11.7	9.1	8.1	32.7
Stop Quality Dif	20.5	14.8	11.7	7.8	5.4	29.1
Veh Quality Dif	16.1	12.2	7.6	6.0	3.7	22.4
Concession Fare Constant	5.9	4.3	na	na	na	13.1
Constant	9.5	3.7	1.0	0.7	0.5	8.6
Observations	22,690	16,851	16,852	16,853	16,854	39,877
Interviews	2,872	2,133	2,133	2,133	2,133	5,048
Relative Valuations	<30k	30-60k	60-90k	90-120k	>120k	All
Service Interval / IVT (mins)	0.67	0.61	0.55	0.60	0.36	0.60
Stop Quality / IVT (mins)	18	16	14	14	9	16
Vehicle Quality / IVT (mins)	22	20	14	17	10	19
Value of Onboard Time $/hr	8.91	9.89	12.35	10.80	13.62	10.00
Stop Quality $/trip	2.70	2.56	2.87	2.60	2.01	2.66
Vehicle Quality $/trip	3.27	3.27	2.97	3.15	2.22	3.18

Figure 7.23 Relative valuations by personal income



7.19 Standardising for service interval, trip length and income

The preceding analysis established four strong interactions. First, vehicle quality sensitivity increased with trip length. Second, respondents were more sensitive to service interval the more frequent the service. Third, respondents with higher incomes were more sensitive to travel time. Fourth and also related to income, respondents with higher incomes were more sensitive to vehicle quality.

To take account of these four interactions, the parameters for IVT, service interval and vehicle quality were standardised. Given that standardisation was quite technical, only a summary is provided here with appendices P, Q and R providing fuller details (see part 3 of this report).

Standardisation involved four steps. In step 1, the nature and strength of the effect was assessed by analysing the market segment results. For three of the interactions, the relationship was linear as can be seen from figure 7.24. The exception was service interval where the relationship was curvilinear. In fitting the functions, weighted regression was used with the weights reflecting the relative accuracy of each market segment estimate.

Having estimated the slope and intercept parameters, step 2 standardised the functions by dividing by the mean of the data. Thus, the service interval function was standardised at the average service interval of 23 minutes, IVT at the average time of 27 minutes and the two income functions at $40,800.

The third step applied the standardisation function to each SP observation. Thus for IVT, the standardisation function was calculated for the income level of the respective respondent and then multiplied with the IVT difference for each SP choice. In this way, IVT differences for respondents with higher than average incomes were factored up and factored down for respondents with lower than average incomes.

The fourth step re-estimated the models. Table 7.19 presents the standardised model. In theory, parameter size should not be affected (since the overall parameter was estimated at the average of the dataset) and all that should occur is an improvement in explanatory power of the attributes reflecting larger t values.

This was in fact largely the case but some changes did occur due to the omission of the model constants during income standardisation. When reintroduced after standardisation, their size was reduced which was considered a beneficial effect. However, because the attribute parameters were repositioned, the relative valuations changed. The value of service interval expressed in IVT minutes increased from 0.6 to 0.7 and the value of stop quality increased from 16 to 18 minutes. However the value of vehicle quality remained unchanged at 19 minutes.

The fare-based valuations also changed. The value of IVT declined from $10/hour to $9.09/hour and the value of vehicle quality decreased from $3.18 to $2.86 per trip whereas the value of stop quality increased slightly from $2.66 to $2.73 per trip.

Figure 7.24 Stated preference sensitivity interaction effects

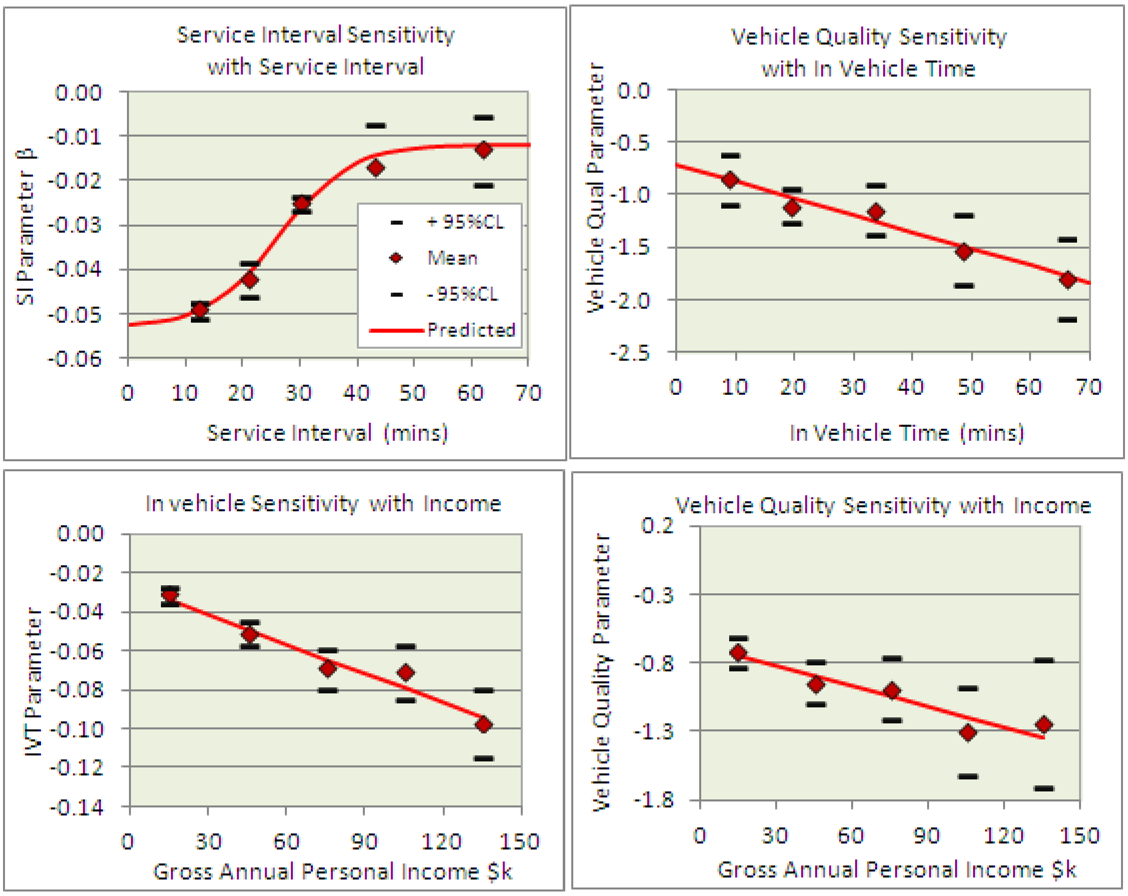


Table 7.19 Overall standardised model

Parameter Estimates	Standardised	Unstandardised
SI Dif	-0.037	-0.036
IVT Dif	-0.054	-0.060
Fare Dif	-0.354	-0.360
Stop Qual Dif	-0.967	-0.959
Veh Qual Dif	-1.011	-1.143
Concession Fare Constant	-0.313	-0.539
Constant	-0.265	-0.326
|t| Values	Standardised	Unstandardised
SI Dif	38.1	36.0
IVT Dif	33.5	30.0
Fare Dif	31.8	32.7
Stop Quality Dif	29.6	29.1
Veh Quality Dif	23.7	22.4
Concession Fare Constant	7.7	13.1
Constant	7.7	8.6
Observations	39,877	39,877
Interviews	5,048	5,048
Relative Valuations	Standardised	Unstandardised
Service Interval / IVT (mins)	0.70	0.60
Stop Quality / IVT (mins)	18	16
Vehicle Quality / IVT (mins)	19	19
Value of Onboard Time $/hr	9.09	10.00
Stop Quality $/trip	2.73	2.66
Vehicle Quality $/trip	2.86	3.18

SI standardised at a service interval of 23 minutes, Vehicle quality standardised at an in vehicle time of 27 minutes and IVT and Vehicle Quality standardised at an income of $40.8k.

7.20 Value of IVT

The value of time increased from $5/hour at zero income to $18.50/hour at $135,000 per year. At the average annual income of $40,800, the value of time was $9.09/hour.

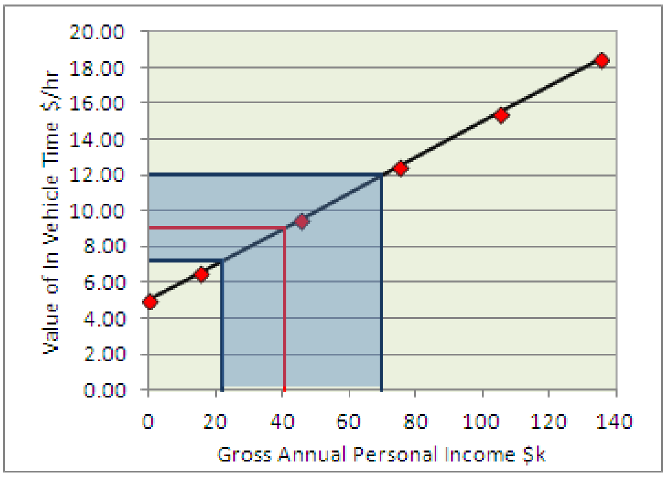
Table 7.20 Value of in-vehicle time $/hour

Personal Income $000 p.a.	Value of In Vehicle Time $/hr^
0	5.00
15	6.50
45	9.50
75	12.50
105	15.50
135	18.50
Average = 40.8	9.09

^rounded to nearest 50c

As average incomes ranged from $22,000 to $70,000 across the bus and train routes surveyed (see figures 4.14 and 4.15), the 'route' values of time ranged from $7.20/hour to $12/hour (the shaded area in figure 7.25).

Figure 7.25 Value of in-vehicle time with personal income



Wallis et al (2013) undertook a review of public transport service level valuations as part of a review study for the Transport Agency of evaluation procedures.[72]

Three New Zealand surveys were reviewed: a 1990 survey of Wellington bus, car and rail users for New Zealand Rail (SDG 1990); a survey of bus and rail users in Wellington and Auckland (Beca Carter et al 2002); and a survey of Wellington and Auckland public transport users on bus and train reliability (Vincent 2008). [73]

In addition 24 Australian studies were reviewed most of which were undertaken in Sydney. A summary of the studies including the New Zealand studies is provided in appendix U (see part 3 of this report).

A summary of the estimates values of time is presented in table 7.21. For New Zealand, the average value of time was $6.30/hour based on the three studies after updating them to 2012 using a GDP per capita model developed by Douglas and Wallis (2012). The average of the 25 Australian estimates was updated to 2012 and converted to New Zealand dollars, which at an exchange rate of NZ$1.278/Aus$, was 15/hour. Thus the Australia study based value was more than twice that derived from the three New Zealand studies.

Also presented in table 7.21 are the recommended values for commuting to work and non-work trips given in the New Zealand EEM and the *Australian national guidelines for transport system management* as calculated by Wallis et al (2013). The EEM gives a value of $7.41/hour for commuting to work and $4.81/hour for other trip purposes (derived from the Beca Carter et al (2002) study). Using a work commuting share of 45% (see table 3.1) produces an overall average value of $6/hour which is close to the 'three study' average of $6.30/hour.

The Australian NGTSM values, as reported by Wallis et al (2013), when converted to New Zealand dollars were NZ$16.80/hour for commuting to work and NZ$14.30/hour for other trips which gives an overall average (45% commuting share) of $15/hour.

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[72] The review covered the value of time and service interval (see next section). Studies undertaken in New Zealand and Australia over a two decade period (1990–2012) were assessed. The Australian review utilised work undertaken by Douglas Economics for the Bureau of Transport Statistics, NSW (Douglas Economics 2013). The review of the value on IVT was broadened in a conference paper presented at ATRF 2013 by Douglas and Wallis (2013).

[73] The pilot market research of this study was also included as a fourth observations but has been excluded.

Thus the pricing strategies' estimate of $9.09/hour is midway between the New Zealand and Australian estimates. The value is 44% higher than the New Zealand $6.30/hour and 40% less than the Australian estimate of $15/hour.

Table 7.21 Comparison of value of in-vehicle time estimates

Study	Year	Estimate	2012 Est*
SDG (1990)	1990	2.87	5.47
Beca (2002)	2001	4.52	5.86
Vincent (2008)	2008	7.71	7.48
NZ Average (3 estimates)	na	na	6.30
Australia (25 estimates) $NZ^	Various	na	15.00
Pricing Strategies	2012/13	9.09	9.09
NZ & Australia Guideline Figures	Work	Other	Overall**
NZ EEM	7.41	4.81	6.00
Australia NGTSM^ $NZ	16.80	14.30	15.40

* updated using a GDP/capita regression equation by Douglas & Wallis (2013)
^ Converted at an exchange rate of $NZ1.278/Aus
** commuting to work share of 45% (ref Table 3.2.1)

For updating the value of time, the obvious candidate that emerges from the pricing strategies research is personal income. Given the predicted income relationship, the implied update factor or elasticity would be much less than proportional. For example, a 10% increase on the average income of $40,800 would increase the value of time from $9.09/hour to $9.50/hour. The elasticity of the percentage change in the value of time to the percentage change in income is 0.45. Equation 7.3 shows the elasticity calculation with the income standardisation parameter inserted $(\delta = 0.1)$, a value of time of $9.09/hour and an average income of $40,800.

$$\varepsilon = \delta \frac{PY_O}{VOT_O} = 0.1 \frac{40.8}{9.09} = 0.45 \qquad \text{(Equation 7.3)}$$

7.21 Value of service interval

The valuation of service interval increased with service frequency. The valuation was also affected by personal income, albeit indirectly, through an increasing IVT sensitivity which reduced the relative value of service interval.

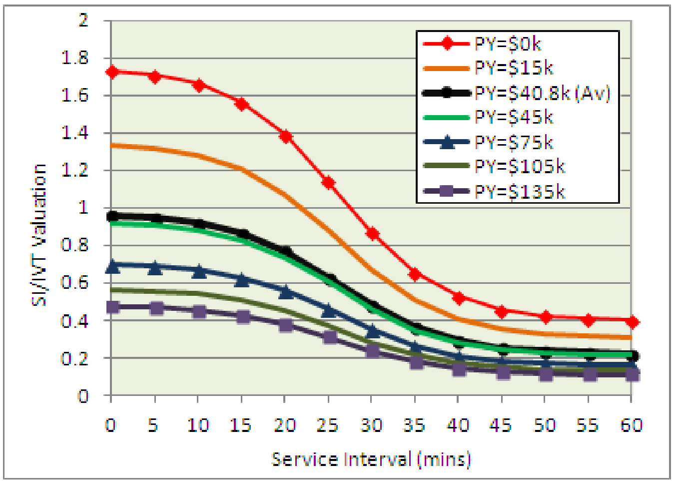
The valuation of service interval for a particular service interval (ie buses every X minutes) and income level is presented in table 7.22. Figure 7.26 graphs the valuations.

The shaded area of the table is of the most relevance taking into account the observed bus and train frequencies and the incomes of bus and train passengers on the routes surveyed.

Table 7.22 Service interval/in-vehicle time valuation

	Personal Income $k p.a.						AV PY
SI mins	0	15	45	75	105	135	40.8
0	1.73	1.34	0.92	0.70	0.56	0.47	0.96
5	1.71	1.32	0.91	0.69	0.56	0.47	0.95
10	1.66	1.28	0.88	0.67	0.54	0.45	0.92
15	1.56	1.21	0.83	0.63	0.51	0.43	0.87
20	1.39	1.07	0.74	0.56	0.45	0.38	0.77
25	1.14	0.88	0.60	0.46	0.37	0.31	0.63
30	0.87	0.67	0.46	0.35	0.28	0.24	0.48
35	0.66	0.51	0.35	0.27	0.21	0.18	0.36
40	0.53	0.41	0.28	0.21	0.17	0.14	0.29
45	0.46	0.35	0.24	0.18	0.15	0.13	0.25
50	0.42	0.33	0.23	0.17	0.14	0.12	0.24
55	0.41	0.32	0.22	0.17	0.13	0.11	0.23
60	0.40	0.31	0.21	0.16	0.13	0.11	0.22
AV SI: 23	1.26	0.97	0.67	0.51	0.41	0.34	0.70

Figure 7.26 Relative valuation of service interval



At the average income of $40,800, the service interval valuation was 0.92 for a high frequency service departing every 10 minutes. For a 20-minute service, the valuation declined to 0.77 and to 0.48 for a half-hourly service.

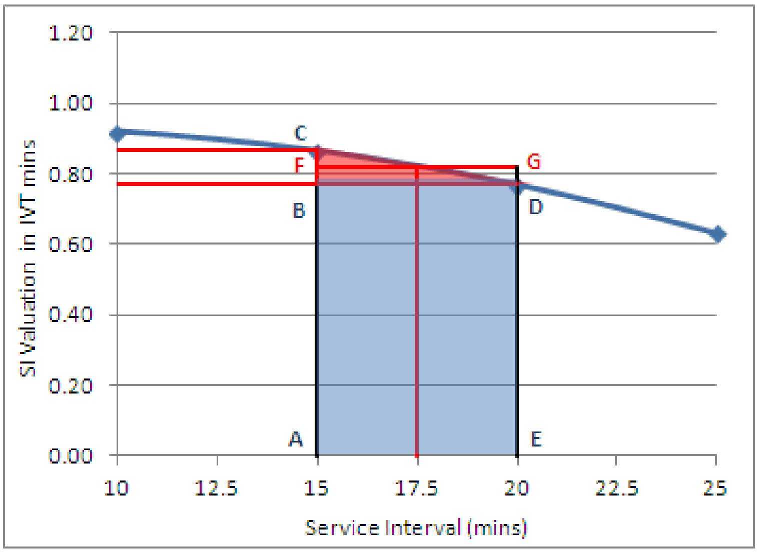
In terms of the waiting time, the average wait for a 10-minute service was 6.3 minutes. Thus the implied value of waiting time in IVT minutes would be 1.46. This valuation compares with a value of 1.84 had random arrivals (waiting half the headway) been assumed. The waiting time function presented in section 4.5 can be used to estimate wait/IVT valuations for all service intervals.

Calculating the benefit from a change in service interval would be straightforward with a constant SI/IVT valuation. For example, if the relative valuation of service interval was the same as IVT (ie 1), the benefit of reducing the service interval from 20 to 15 minutes would be 1x(20-15) which is five minutes (in other words a rectangle of dimension 1x5mins).

Given that the service interval/IVT function is curvilinear, exact calculation of benefit requires mathematical integration. A close approximation can be achieved by using trapezoids. It is worth stating that the benefit is not calculated by multiplying the service interval by the relative valuation at each service interval and working out the difference.[74]

Figure 7.27 shows how the benefit should instead be calculated using a 20 to 15 minute service interval reduction as an example. At 20 minutes, the service interval valuation from table 7.23 (av PY) is 0.77 and at 15 minutes it is 0.87. Given the service interval valuation changes, the benefit is equal to the trapezoid ACDE (the area under the relative valuation curve). The trapezoid comprises the rectangle ABDE produced by the service interval valuation at 20 minutes (0.77) multiplied by the difference in service interval (20-15) which is 4.09 minutes. The blue triangle BCD then needs to be added. This is half the difference in the service interval valuation ½(0.87-0.77) multiplied by the difference in service interval (20-15) which is 0.25 IVT minutes. The total benefit is therefore 4.1 minutes (3.85+0.25).

Figure 7.27 Calculating the benefit of frequency improvement



A simpler calculation is to take the average height of the trapezium ACGH which is 0.82 (the average of the two service interval valuations in table 7.22 ½{0.87+0.77}). The average valuation (0.82) is then multiplied by the base of the trapezium which is the service interval difference (20-15). The answer is again 4.1 minutes.

If the service interval reduction had been from 20 to 10 minutes, the most exact method would be to add the trapezoid for 15-10 minutes to the trapezoid 20-15 minutes. If the service interval is not a multiple of five minutes, the most accurate method is to calculate the service interval valuation at minute intervals (by interpolation) then work out the trapezoid benefits for each one-minute interval and sum them.

Table 7.23 compares the estimate with other New Zealand and Australian estimates reviewed by Wallis et al (2013). Again, there were only three studies, two of which were undertaken in 1990 and 1991. The average of the three studies was 0.46. Twenty-three Australian studies were also reviewed which gave a higher figure of 0.72 which is close to the pricing strategies estimate of 0.70. Appendix U (see part 3 of this report) presents a summary of the studies reviewed.

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[74] Thus for a reduction in service interval from 20 to 15 minutes, the benefit is <u>not</u> 0.77x20 - 0.87x15 which would equal 2.35 minutes.

Table 7.23 Comparison of service interval valuations

Study	Year	Estimate
SDG (1990) - Wellington	1990	0.37
SDG (1991) - Auckland	1991	0.38
Beca (2002) - AUC & WTN	2001	0.63
NZ Average (3 estimates)	na	0.46
Australia (23 estimates)	Various	0.72
Pricing Strategies (at mean of data)	2012/13	0.70

To determine the willingness to pay, the value of time needs to be applied. For the example for the 20-15 minute reduction in service interval, the benefit in dollars for passengers with the average income of $40,800 would be worth 62 cents per trip (4.1mins x $9.09/hour/60). At the average fare of $4/trip (table 4.11), the percentage willingness to pay would be 15.5%.

7.22 Valuation of stop quality

The valuation of stop quality was constant in dollar terms but declined when measured in IVT minutes (due to the effect of personal income). Table 7.24 presents the IVT and fare valuations. For the average income of $40,800, the IVT valuation was 18 minutes. The value was highest at 32.6 minutes at a notional zero income. The value then declined to 8.9 minutes at an annual income of $135,000. The fare valuation was constant at $2.73 per trip.

Table 7.24 Valuation of stop quality

	Gross Annual Personal Income $k						
Valuation	$0k	$15k	$45k	$75k	$105k	$135k	$40.8k
IVT Valuation mins	32.6	25.1	17.3	13.1	10.6	8.9	18.0
Fare Valuation $/trip	2.73	2.73	2.73	2.73	2.73	2.73	2.73

Note: Value of improving stop/station quality from very poor to very good

These valuations apply to a maximum overall rating improvement from 0% to 100%, in other words with everyone valuing the base as very poor (0%) and the improvement as excellent (100%). This will almost certainly never happen. The observed range in the stop/station ratings presented in chapter 6 was much narrower. For bus stops, the lowest observed rating was 46% for Belfast/Casebrook/Northcote/Redwood in Christchurch and also Churton Park in Wellington. The highest rating was 80% for Albany bus station on the Northern Express. Thus the maximum range observed was 34% (46% to 80%).

In order to calculate a time or money valuation, the rating needs to be transformed by applying the power function as described in section 7.5. For stop/station, the power parameter was 0.7. Equation 7.4 shows how the power function is applied to the maximum observed rating 'change' of 46% to 80% to derive a transformed rating change ($TRF(R\%)$) of 28%.

$$TRF(R\%) = R\%_2^{0.7} - R\%_1^{0.7} = 0.8_2^{0.7} - 0.46_1^{0.7} = 0.86 - 0.58 = 0.28 \quad \text{(Equation 7.4)}$$

The transformed change of 28% is then multiplied by the valuation, either the 18-minute IVT valuation or the $2.73 fare valuation. For the IVT valuation, the improvement would be worth 5.1 minutes or 76 cents or 19% of the average fare of $4 per trip. Applying a fare elasticity of -0.3 would forecast a patronage increase of 5.7%.

For rail stations, the ‘before and after’ analysis of Wellington stations (section 6.28) presented an example of an improved station rating from 65% to 85%. The transformed rating change ($TRF(R\%)$) would be 15%, equation 7.5.

$$TRF(R\%) = R\%_2^{0.7} - R\%_1^{0.7} = 0.85_2^{0.7} - 0.65_1^{0.7} = 0.89 - 0.74 = 0.15 \quad \text{(Equation 7.5)}$$

The 15% change would be worth 2.7 minutes. In dollar terms the improvement would be worth 41 cents or 10% of the average $4 fare. Applying a fare elasticity of -0.3 would forecast a patronage increase of 3%.

Rather than use equations 7.4 and 7.5 in combination with the valuations in table 7.24, a set of lookup tables have been prepared in table 7.25. A matrix of values is presented that tabulates rating improvements (and deteriorations) from base values varied from 0% to 100% at intervals of 10%. The top table is not actually needed because it is possible to look up a time or fare valuation from the second and third tables respectively. As an example, an improvement from 40% to 70% would be worth 4.5 minutes or 68 cents. It should be stressed that the table is computed for an average income of $40,800; the values would need computing using equation 7.4 if different income levels were used.

Table 7.25 Valuation of stop quality

Transformed Change in Overall Stop Rating

Base Stop Quality Rating	New Stop Quality Rating 0%	10%	20%	30%	40%	50%	60%	70%	80%	90%	100%
0%	0%	20%	32%	43%	53%	62%	70%	78%	86%	93%	100%
10%	-20%	0%	12%	23%	33%	42%	50%	58%	66%	73%	80%
20%	-32%	-12%	0%	11%	20%	29%	38%	45%	53%	60%	68%
30%	-43%	-23%	-11%	0%	10%	19%	27%	35%	42%	50%	57%
40%	-53%	-33%	-20%	-10%	0%	9%	17%	25%	33%	40%	47%
50%	-62%	-42%	-29%	-19%	-9%	0%	8%	16%	24%	31%	38%
60%	-70%	-50%	-38%	-27%	-17%	-8%	0%	8%	16%	23%	30%
70%	-78%	-58%	-45%	-35%	-25%	-16%	-8%	0%	8%	15%	22%
80%	-86%	-66%	-53%	-42%	-33%	-24%	-16%	-8%	0%	7%	14%
90%	-93%	-73%	-60%	-50%	-40%	-31%	-23%	-15%	-7%	0%	7%
100%	-100%	-80%	-68%	-57%	-47%	-38%	-30%	-22%	-14%	-7%	0%

Value of Change in Stop Quality in In vehicle time mins

Base Stop Quality Rating	New Stop Quality Rating 0%	10%	20%	30%	40%	50%	60%	70%	80%	90%	100%
0%	-	3.6	5.8	7.8	9.6	11.2	12.6	14.1	15.5	16.8	18.0
10%	-3.6	-	2.2	4.2	6.0	7.6	9.0	10.5	11.9	13.2	14.4
20%	-5.8	-2.2	-	2.0	3.6	5.2	6.9	8.1	9.6	10.8	12.3
30%	-7.8	-4.2	-2.0	-	1.8	3.4	4.9	6.3	7.6	9.0	10.3
40%	-9.6	-6.0	-3.6	-1.8	-	1.6	3.1	4.5	6.0	7.2	8.5
50%	-11.2	-7.6	-5.2	-3.4	-1.6	-	1.4	2.9	4.3	5.6	6.9
60%	-12.6	-9.0	-6.9	-4.9	-3.1	-1.4	-	1.4	2.9	4.2	5.4
70%	-14.1	-10.5	-8.1	-6.3	-4.5	-2.9	-1.4	-	1.4	2.7	4.0
80%	-15.5	-11.9	-9.6	-7.6	-6.0	-4.3	-2.9	-1.4	-	1.3	2.5
90%	-16.8	-13.2	-10.8	-9.0	-7.2	-5.6	-4.2	-2.7	-1.3	-	1.3
100%	-18.0	-14.4	-12.3	-10.3	-8.5	-6.9	-5.4	-4.0	-2.5	-1.3	-

Value of Change in Stop Quality in Fare $/trip

Base Stop Quality Rating	New Stop Quality Rating 0%	10%	20%	30%	40%	50%	60%	70%	80%	90%	100%
0%	-	0.55	0.87	1.17	1.45	1.69	1.91	2.13	2.35	2.54	2.73
10%	-0.55	-	0.33	0.63	0.90	1.15	1.37	1.58	1.80	1.99	2.18
20%	-0.87	-0.33	-	0.30	0.55	0.79	1.04	1.23	1.45	1.64	1.86
30%	-1.17	-0.63	-0.30	-	0.27	0.52	0.74	0.96	1.15	1.37	1.56
40%	-1.45	-0.90	-0.55	-0.27	-	0.25	0.46	0.68	0.90	1.09	1.28
50%	-1.69	-1.15	-0.79	-0.52	-0.25	-	0.22	0.44	0.66	0.85	1.04
60%	-1.91	-1.37	-1.04	-0.74	-0.46	-0.22	-	0.22	0.44	0.63	0.82
70%	-2.13	-1.58	-1.23	-0.96	-0.68	-0.44	-0.22	-	0.22	0.41	0.60
80%	-2.35	-1.80	-1.45	-1.15	-0.90	-0.66	-0.44	-0.22	-	0.19	0.38
90%	-2.54	-1.99	-1.64	-1.37	-1.09	-0.85	-0.63	-0.41	-0.19	-	0.19
100%	-2.73	-2.18	-1.86	-1.56	-1.28	-1.04	-0.82	-0.60	-0.38	-0.19	-

Note: For an average income of $40,800 pa

The approach can also be used to value changes in individual stop attributes such as seating. The explanatory model for bus stops was presented in table 6.20. For seating, the logit model parameter was 0.997. Newmarket, Remuera and Parnell had the lowest bus stop seat rating of 36% which compared with an average of 60% for Auckland as a whole. The overall stop rating ($R\%_{ALL}$) for Newmarket, Remuera and Parnell bus stops was 66% (appendix E, table E.3 – see part 3 of this report). Equation 7.6 shows that the overall rating would increase to 71% if the seating at Newmarket, Remuera and Parnell bus stops was improved to that of the average Auckland rating of 60%.

Using equation 7.4 calculates a transformed rating change ($TRF(R\%)$) of 4% which would be worth 0.7 minutes or 11 cents. If the average fare was $4 per trip, the percentage fare valuation would be 3% which would increase patronage by 0.8% (with a fare elasticity of -0.3).

$$R\%_{ALL}{}^{pred} = \frac{R\%_{ALL}\exp\{\sum \beta i[\Delta Xi]\}}{R\%_{ALL}\exp(\sum \beta i[\Delta Xi] + (1 - R\%_{ALL})} = \frac{0.66\exp(0.997[0.6-0.36])}{0.66\exp(0.997[0.6-0.36] + (1-0.66)} = 71\% \qquad \text{(Equation 7.6)}$$

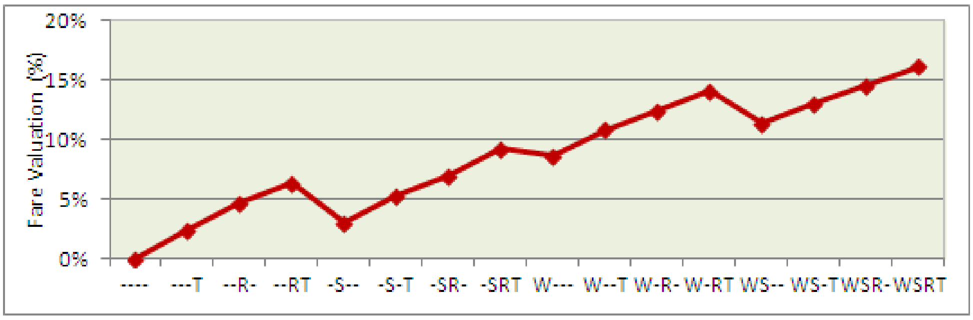
The valuation methodology can also be applied to the bus stop 'facility availability' models. Section 6.10 analysed the bus stop ratings according to facility availability (as perceived by passengers). The predicted ratings have been transferred to table 7.26 to enable facility availability to be valued (for an average trip of 27 minutes and income of $40,800).

The value from providing all facilities at a bus stop is 4.3 minutes or 16% of fare (versus no facilities). Providing shelter on its own (W---) is worth 2.3 minutes or 9% of fare. Providing just seating (-S--) is worth 0.8 minutes or 3% of fare.

At a bus stop with shelter, seating and timetable (WS_T), the additional value of providing real time information (RTI) (WSRT) is worth 0.9 minutes or 3% of fare (4.3-3.4, 16%-13%).

Table 7.26 Valuation of bus stop facilities

Facs	----	---T	--R-	--RT	-S--	-S-T	-SR-	-SRT	W---	W--T	W-R-	W-RT	WS--	WS-T	WSR-	WSRT
Pred R%	46%	50%	54%	57%	51%	55%	58%	62%	61%	65%	68%	71%	66%	69%	72%	75%
TRF(%)	0%	3%	7%	9%	4%	8%	10%	13%	13%	16%	18%	21%	17%	19%	21%	24%
IVT (mins)	0.0	0.6	1.2	1.7	0.8	1.4	1.8	2.4	2.3	2.9	3.3	3.7	3.0	3.4	3.9	4.3
Fare $/trip	0.00	0.10	0.19	0.26	0.12	0.21	0.28	0.37	0.35	0.43	0.50	0.56	0.46	0.52	0.58	0.65
% Fare	0%	2%	5%	6%	3%	5%	7%	9%	9%	11%	12%	14%	11%	13%	15%	16%



The values for stop quality established by the literature review (published separately as part 2 of this report) are summarised in table 7.27. At the top of the list is the SDG (1990) study which valued shelter and seats at six minutes. From table 7.26, the comparable value (WS--) is only three minutes. The study of Sydney bus quality by Hensher and Prioni (2002) valued a shelter with seats, timetable and map at 2.8 minutes or 10% of fare which is similar to the value of 3.4 minutes in table 7.26 (WS_T).

Table 7.27 A review of bus stop and station package values

#	Reference	Package description	Mins	Fare %
1	SDG (1991a) Wellington New Zealand	Shelter and seats vs unprotected bus stop	6	3%
		New vs standard rail station - rail commuters	22	11%
		New vs standard rail station - bus, car and non rail commuters	8	4%
2	PCIE (1995) Sydney rail	10% rating point improvement in station rating^	1.1	4%
3	PPK–PCIE (1998) Sydney bus transitway	Modern bus stop (shelter and seats) – priority evaluator bus users	6	na
		as above car users	17	na
		as above rail users	6	na
4	Hensher and Prioni (2002) (4a) and Hensher et al (2003) (4b) Sydney bus	Sydney bus survey - value of shelter with seats, timetable & map	2.8	10%
5	Wardman and Whelan (2001)	Not covered	na	na
6	Halcrow (2005) Victoria rail	Dandenong (Victoria) regional rail station improvement package estimated by a priority evaluator survey	5.4	91%
7	Douglas and Karpouzis (2006a) Sydney rail	10% rating point improvement in overall station rating*	1.3	7%
		10% rating point increase with trip length+	0.4S-2.4L	3.4%S-9.3L%
		Value of improving from worst (39%) to best station (75%)	4.5	25%
8	Douglas Economics (2005) Wellington rail	Value of Petone station Wellington using priority evaluator	44	115%
9	SDG (2007) London	Worst to best bus stop London 2007 survey	1.9	58%
		Worst to best train station London 2007 survey	3.6	50%
10	Evmorfopoulos (2007) Leeds	Not reported (stop quality included in vehicle value)	na	na
11	AECOM (2009) UK	Bus stop quality package – cities in England	7	13%
12	Outwater et al (2010) USA	Value of premium service stop/station package – average of 4 USA cities	4.4	na
13	Fearnley et al (2011) Norway bus	Bus shelter with seating versus no shelter/seats Norway	13.8	na
14	NZ Transport Agency (2010b) review	EEM (review): Full package of bus stop improvements	4	9%
		Bus station	3	8%
		Rail station	7	15%

^ value for single station (survey values were divided by 2.1 stations); * rating of station passenger boarded:
+ figures given for short S and long L for peak trips.

Comparing the studies is made difficult by the different composition of the 'packages'. Some studies included information such as the Hensher and Prioni study (4) and some, such as the US study (12), included personal security.

The highest package value was 44 minutes estimated using the priority evaluator for the redevelopment of Petone station in Wellington (8) which resulted from a survey focusing attention on station improvements. Next highest was the Norwegian study of bus stop design (13) which estimated a value of 13.8 minutes for bus stops with weather protection and seating. Again, by focusing attention on bus stop facilities, the valuations were over-estimated.

The London bus survey by SDG (9) estimated relatively low IVT values of 1.9 minutes for improving bus stops from worst to best and 3.6 minutes for improving rail stations. Higher values were produced when the values were expressed in terms of fare (58% and 50% respectively). A similar finding was produced by the priority evaluator of Dandenong regional rail services in Victoria (9) which estimated a time value of 5.4 minutes but 91% fare value.

The EEM gives a value of four minutes for a full package of bus stop improvements and seven minutes for a full rail station package. The bus value compares with 5.1 minutes for the worst to best observed bus stop. For rail, the survey found Ava station in Wellington to rate the lowest at 25% and Newmarket in Auckland to rate the highest at 79%. The rating difference of 54% points would be valued at 8.5 minutes (32% of fare) which is comparable to the EEM figure of seven minutes.

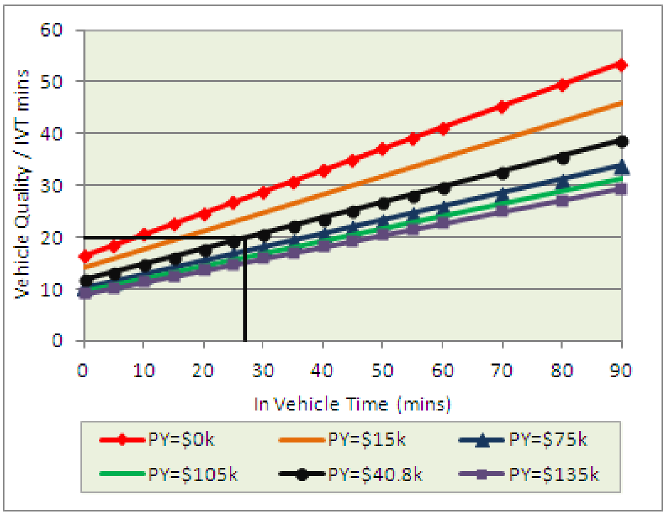
7.23 Valuation of vehicle quality

The value of vehicle quality was found to increase with trip length and income. Of the two factors, trip length was the more powerful. Three sets of valuations are presented in table 7.28: in IVT minutes, dollars of fare per trip and the percentage of fare. The fare/IVT formula presented in section 4.8 is used to calculate the percentage fare valuation.

Table 7.28 Valuation of vehicle quality – value of improving vehicle quality from very poor to very good

	IVT Valuation (mins)							Fare Valuation ($ per trip)							Percentage Fare Valuation (%)							
IVT	Gross Personal Income p.a. $k						AV	Gross Personal Income p.a. $k						AV	Fare	Gross Personal Income p.a. $k						AV
mins	0	15	45	75	105	135	40.8k	0	15	45	75	105	135	40.8k	$/trip	0	15	45	75	105	135	40.8k
0	16.5	14.2	11.7	10.4	9.6	9.1	11.9	1.38	1.54	1.85	2.17	2.48	2.79	1.0	1.52	91%	101%	122%	143%	163%	184%	65%
5	18.6	16.0	13.2	11.7	10.8	10.2	13.4	1.55	1.73	2.08	2.44	2.79	3.14	1.1	1.99	78%	87%	105%	122%	140%	158%	56%
10	20.7	17.7	14.6	13.0	12.0	11.3	14.9	1.72	1.92	2.31	2.71	3.10	3.49	1.2	2.45	70%	78%	94%	111%	127%	143%	51%
15	22.7	19.5	16.1	14.3	13.2	12.5	16.4	1.89	2.11	2.55	2.98	3.41	3.84	1.4	2.92	65%	72%	87%	102%	117%	132%	47%
20	24.8	21.3	17.5	15.6	14.4	13.6	17.9	2.07	2.30	2.78	3.25	3.72	4.19	1.5	3.38	61%	68%	82%	96%	110%	124%	44%
25	26.8	23.0	19.0	16.9	15.6	14.7	19.4	2.24	2.49	3.01	3.52	4.03	4.54	1.6	3.85	58%	65%	78%	91%	105%	118%	42%
30	28.9	24.8	20.5	18.2	16.8	15.9	20.9	2.41	2.69	3.24	3.79	4.34	4.89	1.7	4.31	56%	62%	75%	88%	101%	113%	40%
35	31.0	26.6	21.9	19.5	18.0	17.0	22.4	2.58	2.88	3.47	4.06	4.65	5.24	1.9	4.78	54%	60%	73%	85%	97%	110%	39%
40	33.0	28.4	23.4	20.8	19.2	18.1	23.9	2.75	3.07	3.70	4.33	4.96	5.59	2.0	5.24	53%	59%	71%	83%	95%	107%	38%
45	35.1	30.1	24.9	22.1	20.4	19.3	25.4	2.93	3.26	3.93	4.60	5.27	5.94	2.1	5.71	51%	57%	69%	81%	92%	104%	37%
50	37.2	31.9	26.3	23.4	21.6	20.4	26.9	3.10	3.45	4.17	4.87	5.58	6.29	2.2	6.17	50%	56%	68%	79%	90%	102%	36%
55	39.2	33.7	27.8	24.7	22.8	21.5	28.4	3.27	3.65	4.40	5.14	5.89	6.64	2.4	6.64	49%	55%	66%	77%	89%	100%	36%
60	41.3	35.4	29.2	26.0	24.0	22.7	29.9	3.44	3.84	4.63	5.41	6.20	6.98	2.5	7.10	48%	54%	65%	76%	87%	98%	35%
70	45.4	39.0	32.2	28.6	26.4	24.9	32.8	3.79	4.22	5.09	5.96	6.82	7.68	2.7	8.03	47%	53%	63%	74%	85%	96%	34%
80	49.6	42.5	35.1	31.2	28.8	27.2	35.8	4.13	4.61	5.55	6.50	7.44	8.38	3.0	8.96	46%	51%	62%	73%	83%	94%	33%
90	53.7	46.1	38.0	33.8	31.2	29.5	38.8	4.47	4.99	6.02	7.04	8.06	9.08	3.2	9.89	45%	50%	61%	71%	81%	92%	33%
27	27.7	23.7	19.6	17.4	16.1	15.2	20.0	2.31	2.57	3.10	3.63	4.15	4.68	3.0	4.00	58%	64%	78%	91%	104%	117%	76%

Figure 7.28 Valuation of vehicle quality with income and trip length – value of improving vehicle quality from very poor to very good in in-vehicle minutes



At the mean of the data (IVT of 27 minutes and a personal income of $40,800), improving vehicle quality from very poor to very good was worth 20 minutes or 75% of the base average fare of $4 per trip.

The valuation increased linearly from a 'flag fall' value of 11.9 minutes (zero IVT). At 10 minutes, the value was 15 minutes, at 30 minutes 21 minutes and for an hour trip, the value increased to 30 minutes. Figure 7.28 presents the family of IVT income valuations.

Higher income reduced the time valuation from 28 minutes at 'zero' income to 20 minutes at $45,000 and 15 minutes at $135,000 (for the average 27-minute trip). However, when the value of time was taken into account, the fare valuation doubled from $2.31 per trip at zero income to $4.68 at $135,000.

The values refer to the maximum quality range (very poor to very good). As with station quality, this range would never be encountered in practice. Across the buses surveyed (where there were more than 10 responses), the overall rating ranged from 37% for the 29-year-old Volvo B10 used in Wellington to 79% for the five-year-old BCI bus used in Auckland (a range of 42%).

For trains, the rating ranged from 59% for the Ganz Mavag rolling stock to 82% for the new Matangi cars (a rating range of 23%).

As with stop quality, the valuation was non-linear and used a power function. Equation 7.7 shows how the power function is applied to the 37% to 79% rating difference (reducing the rating change to 34%).

$$TRF(R\%) = R\%_2^{0.65} - R\%_1^{0.65} = 0.79^{0.65} - 0.37^{0.65} = 0.82 - 0.59 = 0.34\% \qquad \text{(Equation 7.7)}$$

The equivalent IVT benefit would be 6.8 minutes (34% x 20 minutes) and the fare benefit would be $1.03 which is 26% of the $4 average fare. With a fare elasticity of -0.3, forecast patronage would increase 7.7%.

For the Ganz Mavag – Matangi train example, the transformed rating change ($TRF(R\%)$) would be 17%, which would be valued at 3.4 minutes. In fare terms, the improvement would be worth 13% of the average fare (a 3.9% patronage increase).

$$TRF(R\%) = R\%_2^{0.65} - R\%_1^{0.65} = 0.82_2^{0.65} - 0.59_1^{0.65} = 0.88 - 0.71 = 0.17 \qquad \text{(Equation 7.8)}$$

Rather than use equations 7.7 and 7.8 in combination with the valuations in table 7.28, a set of lookup tables have been prepared in table 7.29 (for an average trip of 27 minutes and the average income of $40,800).

As with stop quality, the approach can be used to value individual vehicle attributes using the bus and train explanatory models. As an example, table 5.18 established the Wellington trolley bus to rate relatively highly in terms of environmental impacts (noise/emissions) scoring 65% compared with 54% for a pre-Euro engine rated bus. The bus attribute explanation model developed in section 5.20 estimated a parameter of 0.465 for the importance of the environmental rating in explaining the overall rating (table 5.35).

The overall rating of a pre-Euro engine rate bus was 64%. Equation 7.9 can be used to predict the effect of converting the pre-Euro rated bus to a trolley (other things being equal). An adjustment factor has been introduced (compared with equation 7.6) of 0.92 to take account of the 8% who did not give an environmental rating (see table 5.35). The predicted overall rating for the pre-Euro rated bus after conversion to a trolley bus (motive power only) is predicted at 67.4%, an increase of 3.4%.

$$R\%_{ALL}{}^{pred} = \frac{R\%_{ALL} \exp\{\sum \beta i[\Delta Xi.ADJi]\}}{R\%_{ALL} \exp(\sum \beta i[\Delta XiADJi] + (1 - R\%_{ALL})} = \qquad \text{(Equation 7.9)}$$

$$\frac{0.64 \exp(0.465[0.65 - 0.54]0.92)}{0.64 \exp(0.465[0.65 - 0.54]0.92 + (1 - 0.64)} = 67.4\%$$

Using equation 7.9 gives a transformed rating change ($TRF(R\%)$) of 2% which is worth 0.4 minutes or 6 cents. With an average fare of $4 and a fare elasticity of -0.3, a patronage increase of by 0.5% is predicted from replacing a pre euro bus with a trolley bus (based solely on the environmental rating).

Table 7.29 Valuation of vehicle quality – for an average trip of 27 minutes and average personal income of $40,800 pa

Transformed Change in Overall Vehicle Rating

Base Vehicle Quality	New Vehicle Rating 0%	10%	20%	30%	40%	50%	60%	70%	80%	90%	100%
0%	0%	22%	35%	46%	55%	64%	72%	79%	86%	93%	100%
10%	-22%	0%	13%	23%	33%	41%	49%	57%	64%	71%	78%
20%	-35%	-13%	0%	11%	20%	29%	37%	44%	51%	58%	65%
30%	-46%	-23%	-11%	0%	9%	18%	26%	34%	41%	48%	54%
40%	-55%	-33%	-20%	-9%	0%	9%	17%	24%	31%	38%	45%
50%	-64%	-41%	-29%	-18%	-9%	0%	8%	16%	23%	30%	36%
60%	-72%	-49%	-37%	-26%	-17%	-8%	0%	8%	15%	22%	28%
70%	-79%	-57%	-44%	-34%	-24%	-16%	-8%	0%	7%	14%	21%
80%	-86%	-64%	-51%	-41%	-31%	-23%	-15%	-7%	0%	7%	14%
90%	-93%	-71%	-58%	-48%	-38%	-30%	-22%	-14%	-7%	0%	7%
100%	-100%	-78%	-65%	-54%	-45%	-36%	-28%	-21%	-14%	-7%	0%

Value of Change in Vehicle Quality in In vehicle time mins

Base Vehicle Quality Rating	New Vehicle Quality Rating 0%	10%	20%	30%	40%	50%	60%	70%	80%	90%	100%
0%	-	4.4	7.0	9.2	11.0	12.8	14.4	15.8	17.2	18.6	20.0
10%	-4.4	-	2.6	4.6	6.6	8.2	9.8	11.4	12.8	14.2	15.6
20%	-7.0	-2.6	-	2.2	4.0	5.8	7.4	8.8	10.2	11.6	13.0
30%	-9.2	-4.6	-2.2	-	1.8	3.6	5.2	6.8	8.2	9.6	10.8
40%	-11.0	-6.6	-4.0	-1.8	-	1.8	3.4	4.8	6.2	7.6	9.0
50%	-12.8	-8.2	-5.8	-3.6	-1.8	-	1.6	3.2	4.6	6.0	7.2
60%	-14.4	-9.8	-7.4	-5.2	-3.4	-1.6	-	1.6	3.0	4.4	5.6
70%	-15.8	-11.4	-8.8	-6.8	-4.8	-3.2	-1.6	-	1.4	2.8	4.2
80%	-17.2	-12.8	-10.2	-8.2	-6.2	-4.6	-3.0	-1.4	-	1.4	2.8
90%	-18.6	-14.2	-11.6	-9.6	-7.6	-6.0	-4.4	-2.8	-1.4	-	1.4
100%	-20.0	-15.6	-13.0	-10.8	-9.0	-7.2	-5.6	-4.2	-2.8	-1.4	-

Value of Change in Vehicle Quality in Fare $/trip

Base Vehicle Quality Rating	New Vehicle Quality Rating 0%	10%	20%	30%	40%	50%	60%	70%	80%	90%	100%
0%	-	0.67	1.06	1.39	1.67	1.94	2.18	2.39	2.61	2.82	3.03
10%	-0.67	-	0.39	0.70	1.00	1.24	1.48	1.73	1.94	2.15	2.36
20%	-1.06	-0.39	-	0.33	0.61	0.88	1.12	1.33	1.55	1.76	1.97
30%	-1.39	-0.70	-0.33	-	0.27	0.55	0.79	1.03	1.24	1.45	1.64
40%	-1.67	-1.00	-0.61	-0.27	-	0.27	0.52	0.73	0.94	1.15	1.36
50%	-1.94	-1.24	-0.88	-0.55	-0.27	-	0.24	0.48	0.70	0.91	1.09
60%	-2.18	-1.48	-1.12	-0.79	-0.52	-0.24	-	0.24	0.45	0.67	0.85
70%	-2.39	-1.73	-1.33	-1.03	-0.73	-0.48	-0.24	-	0.21	0.42	0.64
80%	-2.61	-1.94	-1.55	-1.24	-0.94	-0.70	-0.45	-0.21	-	0.21	0.42
90%	-2.82	-2.15	-1.76	-1.45	-1.15	-0.91	-0.67	-0.42	-0.21	-	0.21
100%	-3.03	-2.36	-1.97	-1.64	-1.36	-1.09	-0.85	-0.64	-0.42	-0.21	-

The following example looks at how the method can used to evaluate a 'package' of attributes. Suppose a proposal is made to improve the seating and space for bags of the Wairarapa rolling stock (RW_DIE). Table 5.10 gives the base rating for seating of 72% and bags of 68%. After consulting the train designers, the rating after improvement is forecast at 80% for both attributes. Table 5.35 gives the importance parameter for seating of 0.57 and that for bags at 0.195 with only small adjustment parameters of 0.99 and 0.98. Plugging the values into equation 7.10 gives a predicted rating of 79.1%, an increase of 1.1%.

$$R\%_{ALL}{}^{pred} = \frac{R\%_{ALL}\exp\{\sum \beta i[\Delta Xi.ADJi]\}}{R\%_{ALL}\exp(\sum \beta i[\Delta XiADJi] + (1 - R\%_{ALL})} =$$ (Equation 7.10)

$$\frac{0.78\exp(0.57[0.8 - 0.72]0.99 + 0.195[0.8 - 0.68]0.98)}{0.78\exp(0.57[0.8 - 0.72]0.99 + 0.195[0.8 - 0.68]0.98) + (1 - 0.78)} = 79.1\%$$

Given the trip length, income and average fare on the longer Wairarapa line are not typical of the average route table 7.29 should not be used. From appendix B (see part 3 of this report), the average trip length on the Wairarapa line was 68 minutes (table B.10) and the average income was $59,400 (table B.8) and the average fare was $11.17 per trip.

The IVT valuation at 68 minutes and income of $59,400 for the maximum (very poor-excellent) linearly interpolated from table 7.28 was 29.9 minutes and the fare valuation was $5.40. With these valuations, the seat plus bag improvement (1%) would be worth 0.3 minutes or 5 cents. The fare valuation represents 0.4% of the average fare and would increase patronage by 0.1% if a fare elasticity of -0.3 was applied (this may be low for the longer distance route however).

As a basis of comparison, table 7.30 presents summary values from the literature review (published separately in part 2 of this report), expressed in equivalent minutes and as a percentage of the average fare. As can be seen, there is a wide variation in values for the same reasons given for stop quality.[75] Of particular relevance for vehicles was whether 'ongoing' aspects of service such as cleanliness, graffiti removal, staff friendliness, driver performance, announcements were included. In the 1990 Wellington study (1), NSW Transitway study (3) and UK rail refurbishment (5) ongoing aspects were omitted.

The highest package values were estimated by Hensher and Prioni (2004) in a 1999 survey of Sydney bus users (4). The vehicle package offering wide entry doors, very clean and very smooth buses and very friendly drivers was valued equal to 32 minutes of travel time or 90% of fare.

Table 7.30 A review of bus and train vehicle package values

#	Reference	Package description	IVT mins	% Fare
1	SDG (1991a) Wellington	Old to new bus (Wellington)	3.1	11%
		Standard to new bus	1.4	5%
		Standard bus to trolley bus	1	1%
		Old to new train	3.4	8%
		Standard to new train	1.2	4%
		Standard bus to standard train	1.1	4%
2	PCIE (1995) Sydney rail	10% rating point improvement in overall Sydney train rating	1.9	8%
		Improvement from av to best train in Sydney fleet rating	4	16%
3	PPK (1998) Sydney bus transitway	Std bus to transitway bus (incl stop) – SP bus users	0.4	5%
		Std bus to transitway bus (incl stop) – SP rail users	6	51%

[75] In summary, the method of estimation influenced the package valuations with SP and rating valuations tending to be lower than priority evaluator and transfer price estimates. A second factor was how the package value was calculated, ie whether it was (1) a package that was actually presented to respondents enabling a direct estimate to be reported or (2) whether it had been subsequently calculated by adding the estimated values for individual attributes. If (2), the package value may have then been adjusted or constrained. Third, the 'base' quality from which the improvement was measured affected the values. Fourth, as should be expected, some of the variation was due to study context: differences in attribute quality (both base and 'improvement'); differences in fare and travel time against which the qualitative attributes were measured; and differences in respondent and trip profile.

#	Reference	Package description	IVT mins	% Fare
		Std bus to transitway bus (incl stop) – SP car users	5	63%
		New modern bus vs standard bus – PE bus users	5	22%
		New modern bus vs standard bus – PE car users	6	43%
		New modern bus vs standard bus - PE rail users	3	15%
4	Hensher and Prioni (2002) (4a) and Hensher et al (2003) (4b) Sydney bus	1999 survey – wide entry, v.clean & v.smooth, v.friendly driver	32	90%
		2000 survey – wide entry, v.clean, v.smooth, v.friendly driver	19	65%
5	Wardman and Whelan (2001) UK	Train renewal (30-minute trip)	1.3	1.5%
6	Halcrow (2005) Victoria rail	Train package (air con, clean seats, no graffiti safe) PE	4.6	77%
7	Douglas and Karpouzis (2006a) Sydney rail	10% improvement in overall train rating with:	2.2	12%
		• " " " strong trip length and pk/off-pk effects	0.7S–5.3L	5%S–16%L
		• improvement from worst to best train in fleet rating	2.7	15%
		• improvement from average to best train in fleet rating	1.3	8%
8	Douglas Economics (2005) Wellington rail	Vehicles not covered	na	na
9	SDG (2007) London	Worst to best bus 2007 survey	2.4	73%
		Worst to best train 2007 survey	3.6	50%
10	Evmorfopoulos (2007) Leeds	Quality bus package vs std bus (incl. stop attributes) – SP	4.3	9%
		Quality bus package of quality vs std bus (incl. stop attributes) – TP	7.4	15%
11	AECOM (2009) UK	On-bus quality package	14.8	27%
12	Outwater et al (2010) US	Value of premium service package (4 cities)	3.1-5.8	nc
		Salt Lake City – work commuters – bus	4.3	nc
		Salt Lake City – non- work commuters – bus	5.5	nc
		Salt Lake City – work commuters – rail (constant + per min)*	4.3+.13/m	nc
13	Fearnley et al (2011) Norway	Not covered	na	na
14	NZ Transport Agency (2010b) review	Summation of bus (vehicle) attributes ^	5.4	12%
		Summation of train (vehicle) attributes ^	11.4	25%

^sum of attribute values (no downwards adjustment for multiple attributes); * only work model presented

nc: no data on average fares and non commuting value of time to calculate % fare valuations

Next highest was the AECOM study (11) which estimated a value of 14.8 minutes (27% of fare) for a bus quality package including new low-floor buses, with climate control (air conditioning), trained drivers, on-screen displays, audio announcements, CCTV, leather seats, customer charter and an in-vehicle seating plan.

The US study of premium services (12) estimated lower package values of between 3.1 and 5.8 minutes. However, the package covered fewer attributes: wifi, onboard seating availability, seating comfort, temperature control and vehicle cleanliness. For rail, the package value was estimated to increase with trip length (0.13 minutes per minute of onboard train time).

The values for London (9) were 2.4 minutes for bus and 3.6 minutes for rail.

The EEM package values (14) were comprehensive in attributes included but were not halved as recommended in the ATC (2006) guidelines from which they were sourced. The estimated bus value of 5.4 minutes is similar to the US premium service study (12) but is only half the AECOM (11) value. The rail value is higher than the other estimates when measured in train minutes (11.4) but lower when measured in percentage fare (25%).

By comparison, the bus example (calculated for the widest range in observed ratings) was 6.8 minutes versus the EEM figure of 5.4 minutes.

The pricing strategies rail example, which compared 'old' Ganz Mavag with 'new' Matangi rolling stock, produced a value of 3.4 minutes; a value that was a quarter of the EEM value of 11.4 minutes.

7.24 Interaction between quality and travel time

So far the value of time has not been directly related to vehicle quality. Passengers should be willing to pay more to save time the more uncomfortable and/or unpleasant their travelling environment. Thus, passengers should be less willing to pay to save time when sitting in first class than sitting in second class (other things being equal). The same applies to the value of waiting time. As the quality of the stop/station improves, passengers should be willing to pay less to save a minute of waiting time.

This is not to say that passengers will not pay for higher quality; their willingness to pay is the difference in how they value time spent in environments that differ in quality.

The quality/time sensitivity was tested by fitting equation 7.11to the data.

$$Pa = \frac{Z}{1+Z} \qquad \text{(Equation 7.11)}$$

where

$$Z = \exp\left\{\begin{array}{l} \alpha + \alpha_c C + \beta_f \Delta F + \beta_v \Delta V + \beta_{si} \Delta SI + \beta_{wsq} \left\{W_A(1 - SQ_A^{0.7}) - W_B(1 - SQ_B^{0.7})\right\} \\ + \beta_{vvq} \left\{V_A^{Std}(1 - VQ_A^{0.65}) - V_B^{Std}(1 - VQ_B^{0.65})\right\} \end{array}\right\}$$

and where $W_A = 0.681 + 1.767(\sqrt{SI_A})$ and likewise for W_B

Rather than assume a proportional relationship with IVT (by multiplying the quality by the IVT specified in the SP design for service A and B), the model was standardised using the function described in section 7.23. This introduced a 'flag fall' component to reflect ease of boarding/alighting and other attributes such as the outside appearance and 'meeting' the bus driver. The 'factoring' is graphed in figure 7.29.

Figure 7.29 Factoring of in-vehicle time and quality interaction

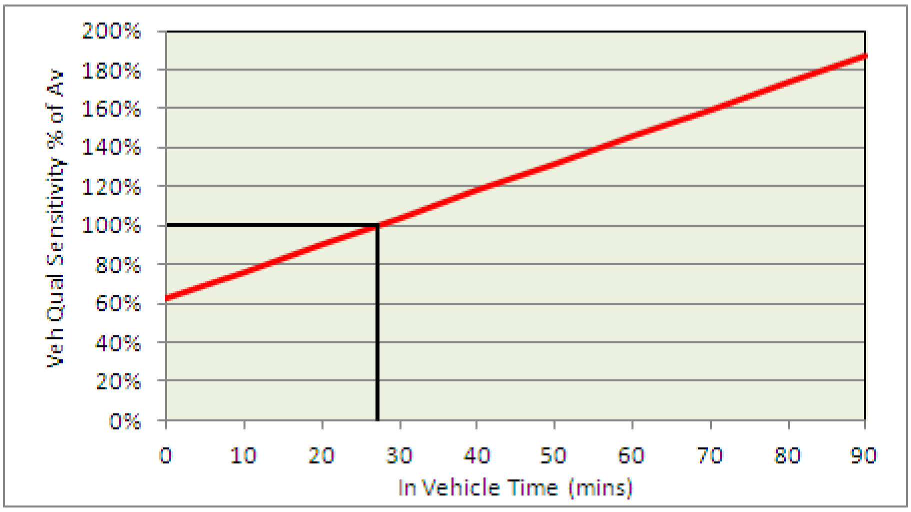


Figure 7.29 shows that for a hypothetical trip taking ‘zero’ minutes, the IVT factor would be 60% of the average (27-minute value) rather than zero, had a proportion relationship been adopted. At 90 minutes, the adjustment increased to nearly 200%.

Wait time was used for the stop quality time interaction since it measured the ‘exposure’ to stop quality better than service interval. Wait times were predicted using the model presented in section 4.5.

The IVT and vehicle quality parameters were income standardised (see appendix P – see part 3 of this report).

Two models were estimated. The first model introduced the vehicle quality/IVT interaction. The second model then introduced the stop quality/wait time interaction.

Table 7.31 presents the vehicle quality/IVT interaction model with standardised parameters. Shown alongside is the basic standardised model for comparative purposes. The goodness of fit of the vehicle quality interaction was less than in the basic model (|t| value reduced from 24.4 to 20.8). A desirable result was the reduction in size of the constants and their |t| values.

Two sets of relative valuations are tabulated. The upper set was calculated for ‘very good’ vehicle quality and, because the sensitivity to IVT was lower, the service interval and stop quality valuations were higher. Conversely, the value of time was ($7.81/hour compared with $9.86/hour in the basic model).

Table 7.31 Vehicle quality * in-vehicle time interaction model

Parameter Estimates	Quality * IVT Interaction	Basic Std Model
SI (SI standardised)	-0.037	-0.037
IVT (Income standardised)	-0.046	-0.060
Fare	-0.351	-0.365
Stop Quality	-0.966	-0.958
Veh Qual * IVT (Income Standardised)	-0.031	-1.072
Concession Fare Constant	-0.359	-0.551
Constant	-0.169	-0.325
|t| Values	All	All
SI (SI standardised)	37.4	37.0
IVT (Income standardised)	29.7	30.0
Fare	31.8	33.2
Stop Quality	29.6	29.0
Veh Qual * IVT (Income Standardised)	20.8	24.4
Concession Fare Constant	8.8	13.1
Constant	5.0	11.6
Observations	39,865	39,865
Interviews	5,046	5,046
Relative Valuations at Very Good Vehicle Quality	Quality * IVT	Basic Std
Av IVT mins	27	27
Service Interval / IVT (mins)	0.80	0.62
Stop Quality / IVT (mins)	21.1	16.0
Vehicle Quality (VP-VG Qual)/min / IVT min	0.69	0.66
Value of Onboard Time (VG Veh Qual) $/hr	7.81	9.86
Stop Quality $/trip	2.75	2.62
Vehicle Quality (VP-VG) $/min	0.09	2.94
Relative Valuations at Average Vehicle Quality	Quality * IVT	Basic Std
Average Vehicle Quality Rating	72%	72%
IVT Parameter at average vehicle quality	-0.052	-0.060
Value of Service Interval/IVT (Av Veh Qual)	0.71	0.62
Value of Stop Quality/IVT (Av Veh Qual)	18.7	16.0
Value of Vehicle Qual (VP-VG) /min/IVT (Av Veh Qual)	0.61	0.66
Value of Onboard Time (Average Veh Qual) $/hr	8.84	9.86

Note * denotes an interaction terms

The lower set of valuations was calculated at the average vehicle quality (72% see table 5.3) which increased the IVT sensitivity parameter to -0.052 as shown by equation 7.12.

$$\beta_v^{av} = \beta_v^{vg} + \beta_{vq}\left(1 - R\%_{vq}^{0.65}\right) = -0.046 - 0.031\left(1 - 0.72^{0.65}\right) = -0.052 \qquad \text{(Equation 7.12)}$$

The increase in IVT sensitivity reduced the service interval valuation to 0.71. The stop quality valuation also reduced to 18.7 minutes and the value of time increased to $8.84/hour.

Thus in terms of the value of time, the average vehicle quality of 72% imposed a cost of around $1/hour compared with a 100% very good quality. For the average trip of 27 minutes, the cost was worth 46 cents (11% of the average $4 fare).

Table 7.32 presents the full model with stop quality interacting with wait time. For comparative purposes, the vehicle quality interaction model and the basic standardised model are presented alongside the full model.

Table 7.32 Vehicle and stop quality * time interaction model

Parameter Estimates	VQ*V & SQ*W Interaction	VQ*V Interaction	Basic Std Model
SI (SI standardised)	-0.028	-0.037	-0.037
IVT (Income standardised)	-0.047	-0.046	-0.060
Fare	-0.373	-0.351	-0.365
Stop Quality * Wait Time	-0.102	-0.966	-0.958
Veh Qual * IVT (Income Standardised)	-0.031	-0.031	-1.072
Concession Fare Constant	-0.369	-0.359	-0.551
Constant	-0.137	-0.169	-0.325
|t| Values	VQ*V & SQ*W	VQ*V	Basic Std
SI (SI standardised)	27.9	37.4	37.0
IVT (Income standardised)	30.6	29.7	30.0
Fare	33.5	31.8	33.2
Stop Quality * Wait Time	29.1	29.6	29.0
Veh Qual * IVT (Income Standardised)	20.3	20.8	24.4
Concession Fare Constant	9.0	8.8	13.1
Constant	4.1	5.0	11.6
Observations	39,865	39,865	39,865
Interviews	5,046	5,046	5,046
Relative Valuations at VG Quality	VQ*V & SQ*W	Quality * IVT	Basic Std
Av IVT mins	27	27	27
Av SI mins	23.4	23.4	23.4
Av Wait mins	9.2	9.2	9.2
Service Interval at VG Stop & VG Veh Qual/IVT (mins)	0.60	0.80	0.62
Stop Quality per wait time minute / IVT (mins)	2.2	21.1	16.0
Vehicle Quality (VP-VG Qual)/min / IVT min	0.65	0.69	0.66
Value of Onboard Time (VG Veh Qual) $/hr	7.60	7.81	9.86
Stop Quality per wait time minute $/trip	0.27	2.75	2.62
Vehicle Quality (VP-VG) $/min	0.08	0.09	2.94
Relative Valuations at Average Vehicle Quality	VQ*V & SQ*W	Quality * IVT	Basic Std
Average Vehicle Quality Rating	72%	72%	72%
Average Stop Quality Rating	66%	66%	66%
IVT Parameter at Av Vehicle Quality	-0.053	-0.052	-0.060
SI Parameter at Av Stop Quality & Av Wait	-0.038	-0.037	-0.037
Value of Service Interval/IVT (Av Veh & Av Stop Qual)	0.72	0.71	0.62
Value of Stop Quality/SI min /IVT (Av Veh Qual)	0.75	0.80	0.68
Value of Vehicle Qual (VP-VG)/min/IVT (Av Veh Qual)	0.58	0.61	0.66
Value of Onboard Time (Average Veh Qual) $/hr	8.54	8.84	9.86

Note * denotes an interaction terms

Goodness of fit for service interval reduced (the t value dropping from 37.4 in the vehicle quality interaction model to 27.9). However on the positive side, the IVT and fare sensitivity parameters increased, and the constant reduced.

The relative valuations required further manipulation since in the full interaction model, the sensitivity to service interval is measured at a very good stop quality rating. Given that stop quality interacted with wait time and not service interval, positioning the values at the average stop quality rating of 66% (table 6.3) required application of the wait to service interval ratio.[76]

At the bottom of the table, the relative valuations at the observed qualities are presented. The valuation of service interval was 0.72 and the value of stop quality per minute of service interval was 0.75 (mid-way between the vehicle interaction and basic model estimates). The value of vehicle quality was 0.58 per

[76] The average wait was 9.2 minutes so the ratio was 0.39. There were slight differences in the average wait and service interval measures depending on the survey (SP, rating or combined) see tables 4.3 and 4.4 and processing of data, see table 4.7.

minute and the value of time was $8.54/hour (30 cents lower than in the vehicle quality model due to the reduced size of the constant).

The rating analysis found that the rating of bus stops (table 6.20) increased as wait times shortened (rail station waiting did not increase). The effect was not particularly strong, however, with the bus stop rating increasing by only 3% for a 10-minute reduction in waiting time. In terms of valuation, the rating effect was worth 0.7 minutes of IVT (assessed from an average bus stop rating of 64%).[77]

7.25 Time and cost multipliers for stop and vehicle quality

The interaction model parameters can be manipulated into time and cost multipliers to be used in demand forecasts and economic appraisals. A key property is 'mode neutrality' since bus and rail are measured on the same rating scale. There is therefore no need to introduce a set of 'alternative specific constants' or time multipliers to represent the qualitative advantage of one mode (usually rail) over the other (usually bus). Instead, the analyst can predict (or assume) vehicle and stop ratings and then apply the parameter values to calculate time or cost factors. Moreover, the ratings and valuations presented here are expressed on a 'continuous' scale. There is no single value to express the advantage of a train over bus.[78]

The relative valuation of vehicle quality needs to be de-standardised using equation 7.13. Plugging in the parameter values for the full interaction model from table 7.32 gives a valuation (VQ_{VP} / IVT) of 0.5 per minute for a 10-minute trip which is the extra time cost of travelling on a very poor quality vehicle (additional to the ten minute travel time itself).

$$VQ_{VP} / IVT_{IVT} = \frac{\beta vqv}{\beta v} VQ_{Std}^{IVT} = \left[\frac{-0.031}{-0.047}\right]\left\{\frac{-0.718 + 0.016(IVT)}{-0.718 + 0.016(27)}\right\} \quad \text{(Equation 7.13)}$$

$$VQ_{VP} / IVT_{10} = [0.65]\{0.76\} = 0.5$$

The valuation can also be expressed in dollars using equation 7.14 which gives an additional cost of 6 cents per minute or 60 cents for the 10-minute trip (26% of the fare).

$$VQ_{VP} / F_{IVT} = \frac{\beta vqv}{\beta f} VQ_{Std}^{IVT} = \left[\frac{-0.031}{-0.373}\right].\left\{VQ_{Std}^{IVT}\right\} \quad \text{(Equation 7.14)}$$

$$VQ_{VP} / F_{10} = [0.08]\{0.76\} = \$0.06$$

To calculate the time cost for a different vehicle quality (VQ_Q / IVT), the value needs to be multiplied by the quality power factor.

$$VQ_Q / IVT = \left\{1 - R\%^{0.65}\right\}\left(VQ_{VP} / IVT\right) \quad \text{(Equation 7.15)}$$

Thus for 70% vehicle quality, the IVT factor would be 0.12/min or 5% of fare. Table 7.33 presents the time and fare (%) factors for different vehicle qualities and trip lengths.

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[77] Only the wait/rating effect was assessed and not the effect of wait time on the stop quality valuation.

[78] The approach has already been applied in Sydney by Douglas Economics (2013b) for the Bureau of Transport Statistics to forecast demand and evaluation a set of light rail proposals. The same rating and SP questionnaires were used with only minor modifications made to survey bus, rail and light rail transport (LRT). In addition, an IVT multiplier survey was undertaken to determine the extent of any intrinsic model preference between bus, rail and LRT additional to the quality rating effect. One worthwhile exercise would be to compare the Sydney and New Zealand valuations thereby extending the range of vehicles and stop/stations covered.

Table 7.33 Vehicle quality time and cost factors

In Vehicle Time Factor (mins)											
Veh Quality	In-Vehicle Time (minutes)										Av
R%	0	10	20	30	40	50	60	70	80	90	27
100%	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
90%	0.03	0.03	0.04	0.04	0.05	0.06	0.06	0.07	0.07	0.08	0.04
80%	0.05	0.07	0.08	0.09	0.10	0.12	0.13	0.14	0.15	0.16	0.09
70%	0.08	0.10	0.12	0.14	0.16	0.18	0.20	0.21	0.23	0.25	0.13
60%	0.11	0.14	0.17	0.19	0.22	0.24	0.27	0.29	0.32	0.34	0.18
50%	0.15	0.18	0.21	0.25	0.28	0.31	0.34	0.38	0.41	0.44	0.24
40%	0.18	0.22	0.26	0.30	0.34	0.38	0.42	0.47	0.51	0.55	0.29
30%	0.22	0.27	0.32	0.37	0.42	0.46	0.51	0.56	0.61	0.66	0.35
20%	0.26	0.32	0.38	0.44	0.50	0.56	0.61	0.67	0.73	0.79	0.42
10%	0.31	0.38	0.45	0.52	0.59	0.66	0.73	0.80	0.88	0.95	0.50
0%	0.41	0.50	0.59	0.68	0.77	0.86	0.95	1.04	1.13	1.22	0.65
Av = 72%	0.08	0.10	0.11	0.13	0.15	0.16	0.18	0.20	0.22	0.23	0.12

Cost Factor - Percentage of Average Fare											
	In vehicle Time (mins) & Fare $/trip (lower row)										Av
Veh Quality	0	10	20	30	40	50	60	70	80	90	27
Rating (%)	$1.52	$2.42	$3.32	$4.22	$5.12	$6.02	$6.92	$7.82	$8.72	$9.62	$4.00
100%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0.0%
90%	0%	2%	3%	4%	5%	6%	7%	8%	9%	10%	3.7%
80%	0%	3%	6%	8%	10%	12%	14%	16%	18%	19%	7.5%
85%	0%	3%	4%	6%	8%	9%	10%	12%	13%	14%	5.6%
60%	0%	7%	13%	17%	21%	25%	29%	33%	37%	41%	15.7%
50%	0%	9%	16%	22%	27%	33%	38%	43%	48%	52%	20.1%
40%	0%	12%	20%	27%	34%	40%	47%	53%	59%	65%	24.9%
30%	0%	14%	24%	33%	41%	49%	56%	64%	71%	78%	30.1%
20%	0%	17%	29%	39%	49%	58%	67%	76%	85%	94%	36.0%
10%	0%	20%	35%	47%	59%	70%	81%	91%	102%	112%	43.0%
0%	0%	26%	45%	61%	76%	90%	104%	118%	131%	144%	55.5%
72%	0.0%	5.0%	8.6%	11.7%	14.6%	17.3%	20.0%	22.6%	25.2%	27.7%	10.7%

The two routes with the highest vehicle ratings were the Outer Loop bus service in Auckland (83%) and the Johnsonville rail line in Wellington (82%). The lowest-rated bus route was the Far South Papakura (400s) service in Auckland (63%) and the lowest-rated rail route was the East Line in Auckland (64%). Thus the rating range was from around 65% to 85%.

Using equation 7.13 gives IVT factors of 0.16 for 65% and 0.07 for 85% for a 27-minute trip, a difference of 0.09 per minute or 2.43 minutes per trip or 32 cents per trip.

The vehicle rating analysis also used individual response data to explain the overall vehicle rating. The estimated parameters (table 5.24 logit model) were used to predict the fare benefit (%) relative to travelling on an eight-year-old standard bus for an average trip. The cost factors are presented in table 7.34 and graphed in figure 7.30.

Table 7.34 Predicted cost factor (% of fare)

Age	Std Bus	Premium Bus	Trolley Bus	Train
0	-1.6%	-4.7%	-2.5%	-5.9%
1	-1.4%	-4.6%	-2.3%	-5.4%
2	-1.2%	-4.4%	-2.1%	-4.8%
3	-1.0%	-4.3%	-1.9%	-4.2%
4	-0.8%	-4.1%	-1.7%	-3.6%
5	-0.6%	-4.0%	-1.5%	-2.9%
6	-0.4%	-3.8%	-1.3%	-2.2%
7	-0.2%	-3.7%	-1.1%	-1.5%
8	0.0%	-3.5%	-0.9%	-0.7%
9	0.2%	-3.3%	-0.7%	0.1%
10	0.4%	-3.1%	-0.5%	1.0%
11	0.7%	-3.0%	-0.3%	1.9%
12	0.9%	-2.8%	-0.1%	2.8%
13	1.1%	-2.6%	0.1%	3.8%
14	1.3%	-2.4%	0.3%	4.8%
15	1.6%	-2.2%	0.6%	5.8%
16	1.8%	-2.1%	0.8%	ne
17	2.0%	-1.9%	1.0%	ne
18	2.3%	-1.7%	1.2%	ne
19	2.5%	-1.5%	1.5%	ne
20	2.7%	-1.3%	1.7%	ne

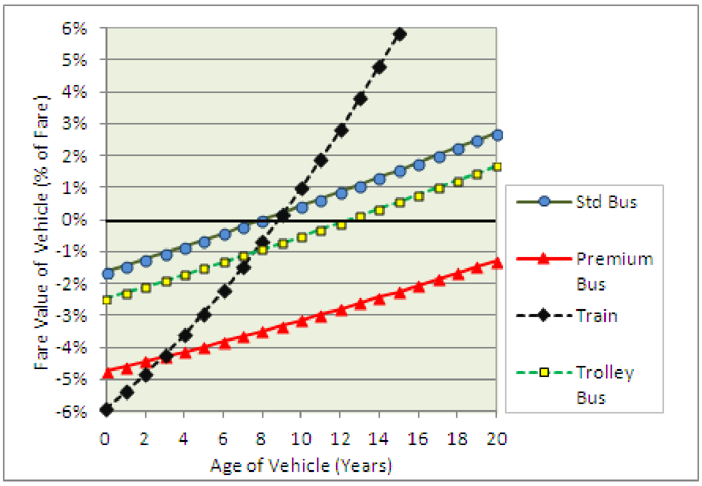
Note: Benefit compared with an eight-year-old standard bus (42 seats) for 27-minute $4 trip.

A new train had the biggest cost factor advantage worth 5.9% of fare compared with an eight-year-old standard bus.

The advantage for a new premium bus was worth 4.7%, a new trolley bus 2.5% and a new standard bus 1.6% of fare.

As vehicles age, the cost factor advantage declined The decline was steepest for trains so that after three years, a train had the same cost factor as a premium bus and after nine years old, a train was valued the same as a standard bus.

Figure 7.30 Predicted cost factor (% of fare)



Note: Benefit compared with an eight-year-old standard bus (42 seats) for 27-minute $4 trip.

In the full interaction model (table 7.32), stop quality was a function of wait time which in turn was a function of service interval (equation 4.2). As a consequence, the IVT and cost factors increased albeit at a declining rate (square root) with service interval, equation 7.16.

$$SQ_{VP} / IVT_{SI} = \frac{\beta sqw}{\beta v}\left\{0.681 + 1.767\sqrt{SI}\right\} = \left[\frac{-0.102}{-0.047}\right] \quad \text{(Equation 7.16)}$$

Unlike the vehicle quality valuations, the cost and IVT factors did not vary with trip length. However, since the cost factor is expressed as a percentage of fare it does decline with trip length (equation 4.3). There is also a tendency for longer distance services to be less frequent. However, in table 7.35, the factors have only been calculated at the average fare of $4 per trip.

At the average stop/station rating of 66% (table 6.4) and service interval of 23.4 minutes (9.2 minute wait), the IVT factor was 7.7 minutes and the cost factor was 16% of the $4 fare. These factors are the respective 'costs' compared with a very good stop/station (R%=100%).

Had the service interval been zero (a conveyor belt) the predicted wait would be 0.7 minutes and the factors would be minimised at 0.6 minutes and 1% of fare. For a 10-minute service frequency, the factors increase to 5.3 minutes and for an hourly service reach 12.1 minutes.

Table 7.35 Stop quality time and cost factors

In Vehicle Time Factor (mins)

	Service Interval (mins) / Wait time (mins) lower row									Av
Stop Quality	0	5	10	15	20	30	40	50	60	23.4
Rating (%)	0.7	4.6	6.3	7.5	8.6	10.4	11.9	13.2	14.4	9.2
100%	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
90%	0.2	1.1	1.5	1.8	2.0	2.5	2.8	3.1	3.4	2.2
80%	0.3	2.2	3.0	3.6	4.1	5.0	5.7	6.4	6.9	4.4
70%	0.5	3.4	4.6	5.5	6.3	7.6	8.7	9.7	10.6	6.8
60%	0.7	4.6	6.3	7.5	8.6	10.4	11.9	13.2	14.4	9.2
50%	0.9	5.9	8.0	9.7	11.0	13.3	15.2	16.9	18.4	11.8
40%	1.1	7.3	9.9	11.9	13.6	16.4	18.7	20.8	22.7	14.5
30%	1.3	8.8	11.9	14.3	16.3	19.7	22.5	25.0	27.3	17.5
20%	1.5	10.4	14.1	17.0	19.4	23.4	26.7	29.7	32.4	20.8
10%	1.8	12.4	16.7	20.1	22.9	27.7	31.7	35.2	38.4	24.6
0%	2.3	15.5	20.9	25.1	28.6	34.6	39.6	44.0	48.0	30.7
66%	0.6	3.9	5.3	6.3	7.2	8.7	10.0	11.1	12.1	7.7

Cost Factor - Percentage of Average Fare

	Service Interval (mins) / Wait time (mins) lower row									Av
Stop Quality	0	5	10	15	20	30	40	50	60	23.4
Rating (%)	0.7	4.6	6.3	7.5	8.6	10.4	11.9	13.2	14.4	9.2
100%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%
90%	0%	2%	3%	4%	4%	5%	6%	6%	7%	4%
80%	1%	5%	6%	7%	9%	10%	12%	13%	14%	9%
70%	1%	7%	9%	11%	13%	16%	18%	20%	22%	14%
60%	1%	10%	13%	16%	18%	21%	24%	27%	30%	19%
50%	2%	12%	17%	20%	23%	27%	31%	35%	38%	24%
40%	2%	15%	20%	24%	28%	34%	38%	43%	47%	30%
30%	3%	18%	24%	29%	34%	40%	46%	51%	56%	36%
20%	3%	21%	29%	35%	40%	48%	55%	61%	67%	43%
10%	4%	25%	34%	41%	47%	57%	65%	72%	79%	50%
0%	5%	32%	43%	52%	59%	71%	81%	90%	98%	63%
66%	1%	8%	11%	13%	15%	18%	21%	23%	25%	16%

Section 6.33 compared the bus stop and train station ratings and showed the average bus stop (aggregated bus stops) rated higher than the average train station largely due to some particularly poorly rated train stations rating in the mid-20%. Table 7.36 converts the ratings into time and fare costs.

Train stations were classified into hub, major and local rail stations and bus stops were classified into bus stations, city centre bus stops and suburban bus stops. Only the hub rail stations rated higher (74%) than the average bus stop which converted into an IVT benefit of 2.5 minutes. Major rail stations rated lower at 60% than the average bus stop and the cost was worth 1.1 minutes. At 56%, 'local' rail stations rated the lowest of all six categories with the lower quality valued at two minutes of IVT.

Bus stations rated the same as hub rail stations at 74%, thus the IVT valuation the same time benefit of 2.5 minutes was calculated. City centre bus stops rated higher at 67% than the average bus stop and the calculated benefit was 0.8 minutes. Suburban bus stops rated at 62% which was lower than the average bus stop and thus the valuation was a 'cost' of 0.5 minutes.

Also tabulated is the highest and lowest rated stop/station in each category. As can be seen, the range was much wider for major and local train stations due to some poorly rated stations in each category. When valued, the cost of the lowest major train station (Taita) was 7.1 minutes and the cost of the lowest-rated local station (Ava and Manor Park) was 11.2 minutes. By contrast the range in the bus stop ratings (partly due to aggregation) was much narrower. The lowest-rated city centre bus stop was only 1% less than the average bus stop so the quality cost was only 0.3 minutes. The lowest-rated suburban bus stop was 46% with a cost o f4.8 minutes.

Table 7.36 Train station and bus stop quality IVT valuations

Mode	Category	Overall Rating			Cost (IVT mins) versus Av. Bus Stop			Number of
		Average	Highest	Lowest	Average	Highest	Lowest	Stops/Stations
Rail	Hub	74%	79%	71%	-2.4	-3.6	-1.7	6
Rail	Major	60%	76%	38%	1.0	-2.9	6.9	19
Rail	Local	56%	76%	25%	2.0	-2.9	10.8	62
Rail	All	58%	79%	25%	1.5	-3.6	10.8	87
Bus	Station	74%	80%	64%	-2.4	-3.8	0.0	6
Bus	City Centre	67%	73%	63%	-0.7	-2.2	0.2	14
Bus	Suburban	62%	71%	46%	0.5	-1.7	4.6	55
Bus	All	64%	80%	46%	Base = 0	-3.8	4.6	75

calculated for a wait of 9.2 minutes

The conventional modelling approach for new modes such as a light rail or busways has been to introduce time multipliers and/or alternative specific constants. For example, the 'quality control' model developed by the US FTA Federal Transit Administration for 'new start' funding applications suggested a time multiplier of 0.8 for rail IVT (compared with 1.0 for bus), FTA (2006a&b). Thus a minute on a train was valued the same as 48 seconds spent on a bus.

The ATC (2006) guidelines splits the mode specific factors 50:50 into an alternative specific constant (ASC) and a time multiplier (IVT factor). The ASC measures the quality of stop/station facilities and boarding the system (steps and payment) and is a 'constant' invariant of trip length but expressed in equivalent IVT minutes. The IVT factor accounts for differences in the quality of travel on the vehicle (such as comfort and air conditioning) and is distance/time related.

A review of estimated mode specific constants and time multipliers of 13 studies (40 ASC values) for bus versus rail, bus versus LRT, busway and ferry estimates was undertaken by Wallis (2013). Only four studies 'compartmentalised' the ASC into ASC and IVT factors. Nine studies presented only ASCs. For a 20-minute trip, the review estimated a bus versus rail mode specific factor of five minutes for the peak and 13 minutes for the off-peak (which would equal 0.25 and 0.65 per minute respectively).

The rating/SP survey results presented here give a much weaker advantage for rail (if there is any advantage at all). Indeed for bus stops versus train stations, the rating advantage lay with bus stops largely because of the poor quality of some rail stations. For vehicles, there was a small rating advantage for a new train over a new bus but this advantage was eroded over about eight years.

The surveys did show an ‘intra mode’ variability in quality between vehicle types and stop/stations much greater than the variability bus and train. Using fixed constants, as has been the conventional approach, ignores this variability. A more informed approach would be to use observed passenger ratings (or forecast ratings for proposed new services based on existing rating information) and use these ratings to estimate the vehicle and stop/station quality factors for forecasting patronage and economic evaluations.

A concern regarding the bus/rail rating comparisons is that the rating scales may be ‘mode specific’ by reflecting ‘expectations’ of quality that are dependent on the modes themselves. Bus respondents could have been using a different rating ‘ruler’ than rail respondents reflecting differences in expectation about the range in quality provided by bus in comparison with rail. In other words a rating of 75% for bus may not be comparable to a 75% for rail.

A revealing analysis would be to ask respondents to rate both rail and bus based on their travel experience and to include both rail and bus in the same SP but with vehicle and stop/station quality varied. Such an analysis has been undertaken in Sydney by Douglas Economics (2014) of bus, rail and light rail users for the Bureau of Transport Statistics. The study, which was undertaken after the New Zealand Pricing Strategies surveys, included a ‘IVT multiplier’ survey which aimed to determine the extent of any ‘intrinsic’ model preference for bus versus rail versus LRT that was additional to any ‘mode specific quality rating difference’ estimated via rating and SP surveys nearly identical to those used in the New Zealand pricing strategies study.[79]

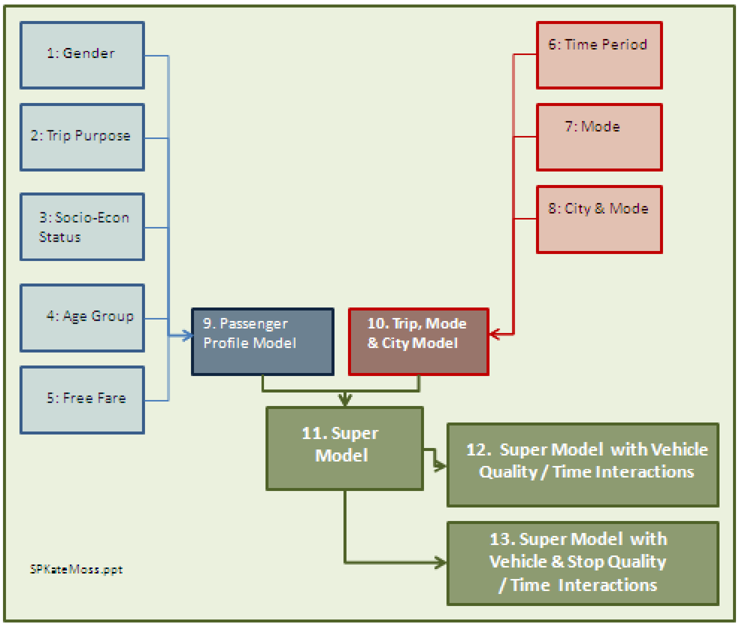
The Sydney surveys found a tendency for respondents to rate their current mode higher than the ‘alternative’ mode. However, when the current and alternative ratings were combined, the ratings for all three modes (bus, rail and LRT) reduced but with the rating differenes remaining roughly the same. In terms of the intrinsic modal preference (ie that preference independent of quality rating differences), the Sydney study established an preference for rail over bus that was worth 2.7 minutes for a 25 minute trip (an IVT multiplier of 0.11) with little difference between LRT and heavy rail.

7.26 Fashioning a super model

The standardised model was extended to take into account the trip and socio-demographic characteristics of the passenger, time of travel, whether bus or train was used and the city the respondent was travelling in. The number of characteristics meant there was a total of 152 variables to consider. Given there were also approximately 40,000 observations, the analytical task was too large to undertake in a single pass. When consulted, Professor Sggih Nosob of Ogato University was of the firm opinion that ‘a big bang approach was out of the question’ and recommended the sequential method shown in figure 7.31.

[79] A worthwhile exercise would be to compare the Sydney and New Zealand valuations thereby extending the range of vehicles and stop/stations covered. In 2014, the same rating/SP questionnaire survey was undertaken in Melbourne of bus, rail and tram users for PTV Victoria so the comparison could be widened (Douglas Economics and Sweeney Research 2014).

Figure 7.31 Fashioning a super model



Three super models were estimated: one model was without quality/time interactions (model 11), one with vehicle quality and IVT interactions (model 12) and one with both vehicle and stop quality interactions (model 13).

The additional profile variables were introduced as interaction terms that multiplied with IVT, service interval, fare, stop quality and vehicle quality. The interaction terms took the attribute level if the characteristic was present or zero if not. Equation 7.17 shows the interaction term for mode which introduced an additional five 'rail' variables, bus being the base mode.

$$Z = \sum_i \beta X + \sum_i \beta_{ir} X_i Rail$$ (Equation 7.17

$Rail$ = dummy variable taking a value of 1 if respondent was using rail else zero

The results of the eight individual models are summarised in figure 7.32 with the parameter estimates provided in appendix S (see part 3 of this report).

Figure 7.32 Market segment models

#	Profile	Market Segment	Service Interval	IVT	Fare	Vehicle Quality	Stop Quality
1	Gender	Male		+++++			
2	Journey Purpose	Education			--		
	Base = Work	Personal Business		---			
		Company Business			++++		
		Shopping	+++				--
		Visiting Friends/Rels				--	
		Entertainment/Hol				--	
		Other					
3	Socio-Economic Status	Student		--	---		
	Base = Employed	Houseperson	+++	++			
		Retired	++++	+++	++++		--
		Unemployed		++++			
4	Age Group	< 18			--		
	Base = 26-64	18-25			---		
		>64	++++	+++	++++		
5	Fare (Base = not free)	Free Fare	+++	++	++++		
6	Time Period	Off-Peak	--				
	Base = AM Peak	PM Peak	----				
		Evening					
		Weekend					
7	Mode (Bus = Base)	Rail	++++	--		----	----
8	Mode & City	Auckland Bus	+++++	++++	+++++		
	Base = Wellington Bus	Christchurch Bus		+++++	++++		
		Auckland Rail				---	
		Wellington Rail	+++++			---	-----

Sensitivity	Legend t	Code
HOT - Most Sensitive	< -5	-----
	5 to -4	----
	-4 to -3	---
	-3 to -2	--
No Effect	<2 to >-2	
	2 to 3	++
	3 to 4	+++
	4 to 5	++++
COLD - Least Sensitive	>5	+++++

The colour codes in figure 7.32 show the direction (+/-) and strength of the effect of the characteristic on the sensitivity to changes in fare, time and quality. Thus in the gender model, males are shown as darkish blue in their sensitivity to IVT. The parameter was positive thereby reducing the sensitivity to IVT (because the main effect should be negative with fewer people choosing the option, the longer the travel time) and the strength of effect was strong (t value was 8.6). This however, was the only statistically significant difference between males and females.

Seven journey purpose effects were significant with the most significant being a lower sensitivity of company business trips to changes in fare; this is logical given that fares would most likely be reimbursed and/or tax deductible. Shopping trips were less sensitive to frequency (service interval) and personal business trips were more sensitive to IVT. The other four effects were positive but weaker.

Ten socio-economic status effects were significant. The strongest negative effects were for retired passengers to be less sensitive to fare and for unemployed passengers to be less sensitive to IVT. The strongest positive effect was for students to be more sensitive to fare.

Five age group effects were significant with retired passengers less sensitive to service interval, IVT and fare. Under 18s and 18–25 year olds were more sensitive to fare.

In model 5, respondents travelling free were less sensitive to service interval, IVT and fare. Given that most travelling free were SuperGold Card passengers the results correlated with the retired segment and the +64 segment.

There were only two significant time period effects which were for off-peak and PM peak respondents to be more sensitive about service frequency.

Rail respondents were different in sensitivity to bus respondents (the base) for four of the five variables. The sensitivity of rail respondents to service interval was lower and the sensitivity to stop, vehicle quality and IVT greater than for bus respondents. The exception was fare where there was no difference in sensitivity between rail and bus respondents.

The last sub-model (8) assessed city and travel mode together (with Wellington bus as the base comparison mode). Nine effects were significant. The strongest effects were for Auckland bus respondents and Wellington rail respondents to be less sensitive to service interval; Christchurch bus respondents to be less sensitive to IVT; and Auckland bus respondents to be less sensitive to fare. Slightly weaker differences were for Auckland bus respondents to be less sensitive to IVT and Christchurch bus respondents to be less sensitive to fare. There were three positive differences. Wellington rail respondents were more sensitive to stop and vehicle quality and Auckland rail respondents were more sensitive to vehicle quality.

The significant respondent profile effects (models 1–5) were then pooled with table 7.31 presenting the parameter estimates. Likewise the significant time period (model 6), mode (7) and mode/city (8) parameters were pooled with table 7.32 presenting the results.

Fifteen respondent profile effects were significant with 'pooling' resulting in 10 effects becoming statistically insignificant (three 'free fare' effects, the retired effects and the 64+ age effects).

Pooling the time period, mode and mode/city models reduced the number of significant effects from 15 down to eight. For time period, the only significant effect was for PM peak respondents to be more sensitive about service interval. The only modal effect was for rail respondents to be more sensitive about stop quality than bus respondents. There were six combined mode/city effects. Wellington rail and Auckland bus respondents were less sensitive to service interval with Auckland bus respondents less sensitive to IVT and fare. Christchurch bus respondents were more fare sensitive and Wellington rail respondents were more sensitive to vehicle quality.

Table 7.37 Respondent profile model (model 9)

Variable	Parameter Estimates	β	STE	t
Main Effect Variables	SI Dif	-0.040	0.001	-37.78
	IVT Dif	-0.062	0.002	-32.11
	Fare Dif	-0.351	0.012	-29.05
	Stop Qual Dif	-0.947	0.034	-27.85
	Veh Qual Dif	-0.936	0.044	-21.13
	Concession Fare Constant	-0.278	0.043	-6.40
	Constant	-0.242	0.035	-6.87
Gender	Male*IVT Dif	0.014	0.002	8.80
Journey Purpose (Base = Work)	Personal Business * IVT Dif	0.006	0.003	2.03
	Company Business * Fare Dif	0.167	0.036	4.60
	Shopping * SI Dif	0.010	0.004	2.74
	Shopping * Stop Qual Dif	-0.333	0.120	-2.78
	Visit Friends/Rels * Veh Qual Dif	-0.323	0.099	-3.27
	Ent/Hol * Veh Qual Dif	-0.394	0.110	-3.59
Socio-Econ Status (Base = Employed)	House Person * Service Interval	0.017	0.006	2.99
	House Person * IVT Dif	0.019	0.006	3.46
	Unemployed * IVT Dif	0.030	0.006	5.06
Age Group (Base = 26-64)	Age < 18 * Fare Dif	-0.057	0.018	-3.15
	Age 18-25 * Fare Dif	-0.038	0.010	-3.77
	Aged 64+ * SI Dif	0.021	0.004	5.09
	Aged 64+ * IVT Dif	0.027	0.006	4.14
	Age 64+ * Fare Dif	0.205	0.033	6.24

standardised model

Table 7.38 Time period, mode and city model (model 10)

Variable	Parameter Estimates	β	STE	t
Main Effect Variables	SI Dif	-0.046	0.002	-28.1
	IVT Dif	-0.055	0.002	-29.6
	Fare Dif	-0.354	0.013	-27.3
	Stop Qual Dif	-0.880	0.038	-23.3
	Veh Qual Dif	-0.851	0.048	-17.8
	Concession Fare Constant	-0.289	0.041	-7.0
	Constant	-0.219	0.035	-6.3
Time Period	PM Peak * SI Dif	-0.017	0.003	-5.9
Mode (Base=Bus)	Rail * Stop Qual Dif	-0.350	0.074	-4.7
City & Mode (Base = WTN Bus)	WTN Rail * SI Dif	0.022	0.003	8.6
	WTN Rail * Veh Qual Dif	-0.445	0.067	-6.7
	AUC Bus * SI Dif	0.015	0.002	6.6
	AUC Bus * IVT Dif	0.010	0.003	3.2
	AUC Bus * Fare Dif	0.034	0.016	2.1
	CHC Bus * Fare Dif	-0.100	0.014	-7.2

standardised model

The significant variables were then combined into the super model shown in table 7.39 that had 22 significant interaction effects.

As well as the basic model (model 11) the table presents the vehicle quality – IVT interaction model (12) and the vehicle quality–IVT and stop quality–wait interaction model (13).[80] As can be seen, parameter significance and goodness of fit slightly worsened when compared with the basic model but all parameters remained significant. A desirable effect was halving the constant (from -0.207 in model 11 to -0.087 in model 13).

The effect of the market segment interactions is shown in the right-hand column for the basic model. Males for example had a 22% lower responsiveness to IVT than females and rail respondents had a 44% higher responsiveness to stop quality than bus respondents.

Table 7.39 Super models

		VQ*V & SQ*W #13			VQ*V #12			No Interaction #11			
Variable	Parameter	Var	β	t	Var	β	t	Var	β	t	ME^
Main Effect Variables	SI (SI std)	SI	-0.040	-22.9	SI	-0.049	-28.4	SI	-0.049	-28.7	na
	IVT (Inc Std)	V	-0.056	-27.1	V	-0.055	-26.4	V	-0.063	-29.6	na
	Fare	F	-0.375	-27.7	F	-0.352	-26.0	F	-0.363	-26.6	na
	Stop Quality	SQW	-0.091	-21.9	SQ	-0.850	-21.6	SQ	-0.851	-21.6	na
	Veh Quality (IVT&Inc Std)	VQV	-0.025	-14.7	VQV	-0.026	-15.0	VQ	-0.789	-16.0	na
	Conc. Fare Constant	FC	-0.307	-7.0	FC	-0.293	-6.7	FC	-0.263	-6.0	na
	Constant	C	-0.087	-2.5	C	-0.113	-3.3	C	-0.207	-5.8	na
Gender	Male*IVT	M*V	0.013	8.3	M*V	0.013	8.3	M*V	0.014	8.7	-22%
Journey Purpose (Base = Work)	Comp Business * Fare	CB*F	0.160	4.4	CB*F	0.160	4.4	CB*F	0.160	4.4	-44%
	Shopping * SI (SI Std)	SH*SI	0.013	3.4	SH*SI	0.011	3.1	SH*SI	0.011	3.1	-22%
	Shopping * Stop Qual	SH*SQW	-0.026	-2.0	SH*SQ	-0.347	-2.9	SH*SQ	-0.335	-2.8	39%
	VFR * Veh Qual (IVT&Inc Std)	VFR*VQV	-0.009	-2.7	VFR*VQV	-0.009	-2.7	VFR*VQ	-0.303	-3.1	38%
	Ent/Hol * Veh Qual	EH*VQV	-0.012	-3.3	EH*VQV	-0.011	-3.2	EH*VQ	-0.409	-3.7	52%
Socio-Econ Status (Base = Employed)	House Person * SI (SI Std)	HP*SI	0.015	2.7	HP*SI	0.016	2.8	HP*SI	0.016	2.9	-33%
	House Person * IVT	HP*V	0.019	3.4	HP*V	0.019	3.4	HP*V	0.017	3.1	-27%
	Unemployed * IVT	UE*V	0.032	5.2	UE*V	0.032	5.3	UE*V	0.028	4.7	-44%
Age Group (Base = 25-64)	Age <18 * Fare	A<18*F	-0.051	-2.8	A<18*F	-0.054	-3.0	A<18*F	-0.043	-2.4	12%
	Age 18-24 * Fare	A1824*F	-0.039	-3.8	A1824*F	-0.042	-4.1	A1824*F	-0.033	-3.2	9%
	Age>64 * SI (SI Std)	A>64*SI	0.020	4.8	A>64*SI	0.021	5.0	A>64*SI	0.021	5.1	-43%
	Age>64 * IVT (Inc Std)	A>64*V	0.026	4.2	A>64*V	0.026	4.2	A>64*V	0.027	4.1	-43%
	Age>64 * Fare	A>64*F	0.201	6.3	A>64*F	0.197	6.2	A>64*F	0.212	6.4	-59%
Time Period	PM Peak * SI	PM*SI	-0.013	-4.5	PM*SI	-0.015	-5.1	PM*SI	-0.015	-5.2	30%
Mode (Base=Bus)	Rail * Stop Qual	R*SQW	-0.034	-4.3	R*SQ	-0.385	-5.2	R*SQ	-0.378	-5.1	44%
City & Mode (Base = WTN Bus)	W.Rail * SI (SI Std)	WR*SI	0.024	9.0	WR*SI	0.024	9.0	WR*SI	0.023	9.0	-48%
	W.Rail * V.Qual (IVT&SI Std)	WR*VQV	-0.016	-6.7	WR*VQV	-0.017	-6.9	WR*VQ	-0.442	-6.6	56%
	AUC Bus * SI (SI Std)	AB*SI	0.013	6.0	AB*SI	0.015	6.7	AB*SI	0.015	6.7	-30%
	AUC Bus * IVT (IVT&Inc Std)	AB*V	0.015	5.0	AB*V	0.015	5.0	AB*V	0.011	3.5	-17%
	AUC Bus * Fare	AB*F	0.044	2.7	AB*F	0.041	2.6	AB*F	0.049	3.0	-13%
	CHC Bus * Fare	C*F	-0.086	-6.1	C*F	-0.089	-6.3	C*F	-0.080	-5.7	22%
	Mc Fadden R Squared	10.4%			10.5%			10.6%			

ME: ratio of market segment parameter over base parameter

The effect on the relative valuations is complicated by the inter-related nature of the market segments. For instance a shopping trip could be made by a male which means there are two interactions to take into account. The shopping trip may also be made on a Wellington train in the PM peak which would introduce two more interaction effects. The best way to take account of all the interaction effects would be to develop a spreadsheet model to compute the combined effect for market segments of interest.

[80] The same variables were used in the interaction models as in the basic model without going through the 10 preliminary models.

Table 7.40 presents the 'first order' interactions for the basic model (model 11). As an example, shopping trips have a lower value of service interval of 0.61 when compared with non-shopping trips (0.78). Company business trips have a higher value of time of $18.70/hour than non-company business trips ($10.44/hour). Here it should be noted that the value of time has been standardised to the survey average so the effect of higher personal incomes amongst company business trips should also be taken into account.

In terms of stop quality, rail respondents valued stop quality (very poor to very good) higher than bus respondents. The difference was worth six minutes (19.5 minutes versus 13.5 minutes). Expressed in terms of fare, the difference was just over a dollar; $3.39 versus the base value of $2.35 per trip.

Passengers visiting friends and relatives valued vehicle quality (very poor to very good) equivalent to 25 minutes ($3.01 per trip) compared with the base group valuation of 12.5 minutes ($2.17 per trip).

Table 7.40 Market segment effects on relative valuations

Valuation	SI/IVT
Shopping (SI)	0.61
House Person (SI & IVT)	0.72
Aged 64+ (SI)	0.78
PM Peak (SI)	1.02
WTN Rail (SI)	0.41
Male (IVT)	1.01
AUC Bus (SI & IVT)	0.65
Unemployed (IVT)	1.39
Base SI Valuation	0.78

Value of IVT $/hr	IVT/F
Company Business (F)	18.70
Age < 18 (F)	9.33
Age 18-24 (F)	9.57
Age 64+ (F & IVT)	14.45
AUC Bus (F & IVT)	10.04
CHC Bus (F)	8.55
Base Value of IVT	10.44

Stop Quality	SQ/IVT	SQ/F
Shopping (SQ)	18.8	3.27
Rail (SQ)	19.5	3.39
Male (IVT)	17.4	-
House Person (IVT)	18.5	-
Age 64+ (IVT) & (F)	23.5	5.65
AUC Bus (IVT) & (F)	16.2	2.71
Unemployed (IVT)	23.9	-
Age 18-25 (F)	-	2.15
CHC Bus (F)	-	1.92
Base Stop Quality Valuation	13.5	2.35

Notes: - denotes no interaction effect

standardised values for income/IVT & SI

Vehicle Quality	VQ/IVT	VQ/F
Visit Friends/Rels (VQ)	25.0	3.01
Entertainment/Hol (VQ)	16.7	3.30
Male (IVT)	16.1	-
House Person (IVT)	17.1	-
Age 64+ (IVT) & (F)	21.7	5.24
AUC Bus (IVT) & (F)	15.0	2.51
Unemployed (IVT)	22.1	-
Company Business (F)	-	3.89
Age < 18 (F)	-	1.94
Age 18-24 (F)	-	1.99
CHC Bus (F)	-	1.78
Base Vehicle Quality Valuation	12.5	2.17

Note: Based on model 11 (basic model without quality/time interactions)

8 Passenger comments

8.1 Introduction

At the end of the rating questionnaire, respondents willing to answer more questions in an internet survey were asked to give their email address. A space was provided for passengers to write any comments.

Figure 8.1 Internet survey and comment space provided on the rating questionnaire

15. If you would be willing to take part in an internet survey about bus service quality please write your email address here……………………………………………………

Comments………………………………………………………………………………………………………

……

……

Thank you, please hand you questionnaire to the surveyor or leave it on your seat for collection

Douglas Economics PO Box 9926 Marion Square Wellington

There were no instructions given to respondents as to what type of comment to make. The responses reflected this. A few did write 'no comment' or 'thanks' and these comments were not typed up.

Some respondents provided useful suggestions for the regional transport authorities, operators and the Transport Agency to consider. Accordingly, the Excel spreadsheet which gave the comments in full was handed over to the Transport Agency.

Section 8.2 presents the number of comments and section 8.3 discusses the coding of the comments. Section 8.4 looks at the propensity to make comments by dividing the number of comments (by category) by the number of returned questionnaires.

Sections 8.5 to.8.9 look at the five attributes of the study, namely vehicle quality, stop/station quality, service frequency, journey time and price.

Section 8.10 looks at ticketing issues which were mostly a concern for Auckland respondents who were surveyed just after the introduction of a new electronic ticketing system (HOP).

Section 8.11 looks at 'reliability' which was the most commented-on attribute.

Sections 8.12 to 8.14 look at 'other' issues, comments of a generally satisfied nature and comments that were made about the questionnaire.

Finally in section 8.15, the willingness of respondents to participate in further research via the internet is presented.

8.2 Number of comments

A space for comments was included on the bus rating questionnaire and on the Auckland rail rating questionnaires. The reason the space for comments was provided on the Auckland rail rating questionnaire but not on the Wellington rail one was largely due to the sequencing of the questionnaires. The Auckland rail survey was done a few months later than the Wellington rail one and, given the number of comments made on the bus rating questionnaires, room was made for a comments space on the Auckland rail questionnaire.

A few respondents wrote comments on the questionnaires (including the SP questionnaire). Where usable, the comments were recorded and included in the analysis. A few passengers made comments about more than one issue. These comments were coded under two headings.

In total, 906 respondents made a comment. Of these, 240 made a comment which was coded into two categories. Thus the total number of comments was 1,146 and included 37 comments written on the SP questionnaires.

The 906 respondents who made a comment represented 15% of the total bus and Auckland rail rating questionnaires completed by passengers (ie excluding the Wellington rail respondents).

The ratio of passengers who made at least one comment was highest for Auckland rail users at 33% and lowest for Wellington bus respondents at 8%. Twenty-four percent of Christchurch respondents and 14% of Auckland bus respondents made a comment.

Table 8.1 Number of comments made

Number of comments	Bus			Rail		
	CHC	WTN	AUC	WTN	AUC	Total
Single comment	121	179	307	26	273	906
Two comments	24	22	98	-	96	240
Total comments	145	201	405	26	369	1,146
Rating q'aire response	595	2,337	2,192	na	839	5,963[(a)]
Single comment/q'aire	20%	8%	14%	na	33%	15%[(a)]

[(a)] excludes Wellington rail respondents.

Figures include 31 passengers who made a comment on the SP questionnaire (six respondents made two comments giving 37 SP comments in total)

8.3 Coding of comments

The comments were coded under headings that reflected the nature of the questionnaire. Five headings covered the five SP attributes namely vehicle quality, stop/station quality, service frequency, journey time and fare (price). Three headings were also given for ticketing issues, reliability and information plus a heading for 'other' comments. Generally favourable but unspecific comments were aggregated under a separate heading and comments made about the questionnaire were also aggregated. Thus, a total of 11 headings were used.

Table 8.2 presents the comments by heading. The number of comments is tabulated and a percentage breakdown is given. The Wellington rail response should be treated with caution given that only 26 comments were written on the questionnaires as there was no space provided.

Table 8.2 Categorisation of comments

#	Description	Number of comments						Percent of total comments					
		Bus			Rail		Total	Bus			Rail		Total
		CHC	WTN	AUC	WTN	AUC		CHC	WTN	AUC	WTN	AUC	
1	Vehicle quality	50	65	80	7	60	262	34%	32%	20%	27%	16%	23%
2	Stop/station quality	9	15	27	3	38	92	6%	7%	7%	12%	10%	8%
3	Service frequency	3	4	23	0	14	44	2%	2%	6%	0%	4%	4%
4	Journey time	1	1	8	1	4	15	1%	0%	2%	4%	1%	1%
5	Price	4	13	10	0	5	32	3%	6%	2%	0%	1%	3%
6	Ticket issues	3	6	18	0	67	94	2%	3%	4%	0%	18%	8%
7	Reliability	22	31	110	9	59	231	15%	15%	27%	35%	16%	20%
8	Information	1	3	1	0	1	6	1%	1%	0%	0%	0%	1%
9	Other	7	12	22	0	26	67	5%	6%	5%	0%	7%	6%
10	General satisfaction	36	39	101	0	89	265	25%	19%	25%	0%	24%	23%
11	Survey Issues	9	12	5	6	6	38	6%	6%	1%	23%	2%	3%
	Total	145	201	405	26	369	1,146	100%	100%	100%	100%	100%	100%

The percentage breakdown was similar for Christchurch and Wellington bus users with a third related to vehicle quality and 7% related to bus stop quality. Several of the comments made regarding 'vehicle quality' (as section 8.5 will show) were compliments about the bus driver or train staff.

Relatively few comments were made about the journey time, frequency or price. Thus vehicle quality comments were the most predominant of the attributes of primary focus.

Among the issues not of primary interest to this study, reliability dominated, accounting for 20% of comments.

A further 20% to 30% of comments expressed general satisfaction which was most prevalent in Christchurch (27%) and lowest in Wellington (13%).

Auckland bus respondents differed from those in Christchurch and Wellington, with a greater preoccupation with reliability issues and a correspondingly lesser interest in vehicle quality. At 27%, the percentage of reliability related comments was nearly twice that of Christchurch and Wellington respondents. At 20%, the percentage of comments about vehicle quality for Auckland was around one half that for the other two cities.

For Auckland rail, ticketing issues accounted for 18% of comments which was attributable to the recently introduced electronic HOP (the card had not yet been introduced onto bus).

No respondents made observations about security or personal safety.[81]

[81] This is in line with research by Kennedy (2008) which found that safety concerns were more likely to be related to the trip to the bus stop or train station, rather than with the stop, station, or vehicle/carriage itself. Kennedy (op cit) also reported that only a small proportion of public transport users readily identified personal security or safety as a concern, with it more usually being seen as 'prohibitive' to increasing public transport journeys, usually after dark. In the daytime, the main barriers to increased public transport usage were insufficient frequency and impracticality (eg public transport did not go to desired destination).

8.4 Propensity to make comments

An alternative way of analysing the comments is to divide their total number by the total number of questionnaires completed to calculate a propensity measure to make comments. Table 8.3 and figure 8.2 present comment 'propensity' (Wellington rail response has been omitted). As can be seen, the 'propensity rates' are higher than the percentages given in table 8.1 because the total number of comments was used and not the number of passengers making a comment.

Figure 8.2 shows a much higher propensity among Auckland rail passengers to make comments than bus respondents. A total of 369 comments were made by 839 passengers who returned a rating questionnaire which gave a comment propensity of 44%. This is higher than the 33% of rail passengers who made a comment because as table 8.1 shows 96 passengers made 'two comments'. Comments expressing general satisfaction had a comment propensity of 11% and survey-related issues 1%. After removing these two categories, the comment propensity reduced to 32%.

Table 8.3 Propensity of respondents to make comments[(a)]

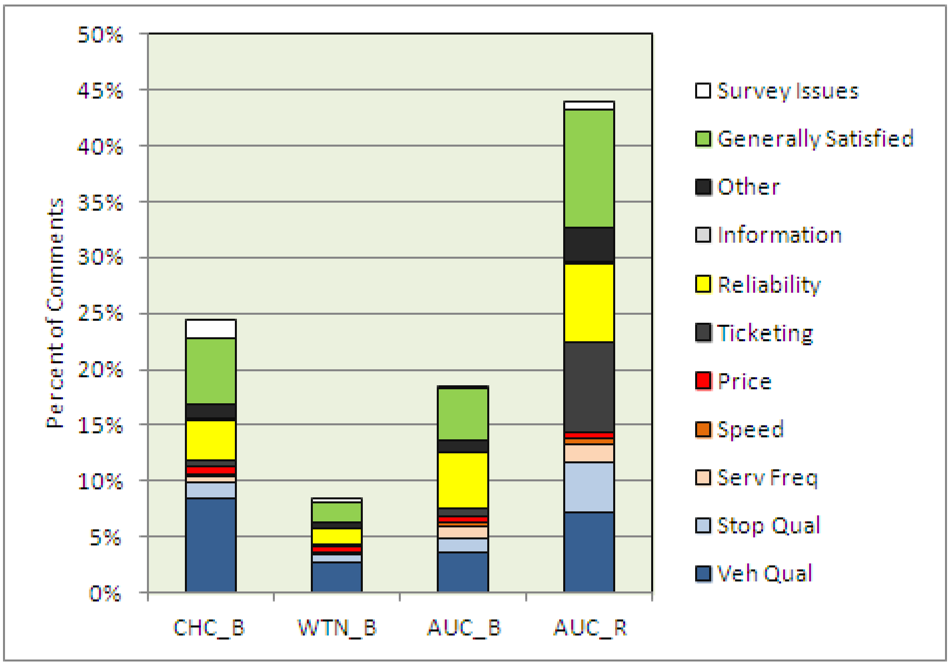
Description	Bus			Rail		Total
	CHC	WTN	AUC	WTN	AUC	
Vehicle quality	8%	3%	4%	na	7%	4%
Stop/station quality	2%	1%	1%	na	5%	2%
Service frequency	1%	0%	1%	na	2%	1%
Journey time	0%	0%	0%	na	0%	0%
Price	1%	1%	0%	na	1%	1%
Ticketing issues	1%	0%	1%	na	8%	2%
Reliability	4%	1%	5%	na	7%	4%
Information	0%	0%	0%	na	0%	0%
Other	1%	1%	1%	na	3%	1%
Generally satisfied	6%	2%	5%	na	11%	4%
Survey issues	2%	1%	0%	na	1%	1%
Total	24%	9%	18%	na	44%	19%

[(a)] Ratio of total comments made over number of completed rating questionnaires

After general satisfaction comments, the largest category was 'ticketing issues' at 8% with the vast majority of rail passengers making comments about the newly introduced HOP card. Compared with Auckland bus respondents, ticketing comments were eight times higher from rail passengers (1%). There were also relatively more comments on the quality of the trains (7%) compared with those on the quality of buses (4%). Comments on the quality of the train stations were at 5% compared with 1% for bus stop comments.

The analysis highlights a higher propensity among Christchurch bus users (24%) to make comments than for Auckland (18%) and particularly Wellington bus users (9%). For vehicle quality, the propensity for Christchurch bus users was twice as high (at 8%) than for Wellington (3%) and Auckland (4%) respondents. Also higher, was the propensity of Christchurch bus users to express general satisfaction at 6% versus 5% for Auckland and 1% for Wellington bus users. Removing the bottom two comment categories (generally satisfied and survey issues) reduced the comment ratio to 16% for Christchurch, 6% for Wellington and 13% for Auckland.

Figure 8.2 Propensity of respondents to make comments[a]



[a] Ratio of total comments made over number of completed rating questionnaires

8.5 Vehicle quality comments

The comments were coded into subcategories. For vehicle quality, 11 sub-categories were used. Table 8.4 presents the breakdown of comments.

For bus, comments about the drivers were the most frequent. Seventeen Christchurch respondents made negative comments about their bus driver which represented 34% of the 50 vehicle quality comments made. A further 15 (30%) were positive comments about the driver. Thus, the positive and the negative comments were reasonably evenly matched.

Table 8.4 Vehicle quality comments

Vehicle quality comments	Number of comments						Percent of vehicle quality comments					
	Bus			Rail			Bus			Rail		
	CHC	WTN	AUC	WTN	AUC	Total	CHC	WTN	AUC	WTN	AUC	Total
Driver/staff issues	17	17	24	0	4	62	34%	27%	30%	0%	7%	24%
Bus or train quality	6	14	15	4	22	61	12%	22%	19%	44%	37%	23%
Rough roads/bumpy train	6	2	3	1	2	14	12%	3%	4%	11%	3%	5%
Not enough seats	4	2	4	2	8	20	8%	3%	5%	22%	13%	8%
Noisy bus or train	1	6	2	1	10	20	2%	10%	3%	11%	17%	8%
Seating quality	0	4	5	0	3	12	0%	6%	6%	0%	5%	5%
Doors on bus or train	0	1	0	0	1	2	0%	2%	0%	0%	2%	1%
Air conditioning	0	0	9	0	7	16	0%	0%	11%	0%	12%	6%
More space for bikes	0	1	0	1	2	4	0%	2%	0%	11%	3%	2%
More luggage space	1	0	1	0	0	2	2%	0%	1%	0%	0%	1%
Generally satisfied with driver/staff	15	16	17	0	1	49	30%	25%	21%	0%	2%	19%
Total vehicle quality	50	63	80	9	60	262	100%	100%	100%	100%	100%	100%

Six examples of the comments made about the Christchurch bus drivers are listed below, three positive comments followed by three negative ones.

+ *Lovely driver, very helpful, it's nice when that happen(s)*
+ *Most bus drivers are very helpful*
+ *Bus driver very helpful, thank you*
- *Sometimes your drivers are so horrible and don't acknowledge people or listen*
- *Bus drivers need basic people skills and drive appropriately*

A similar numbers of good and bad comments were made about Wellington bus drivers but of a slightly larger total number of comments. Thus the percentage was slightly smaller at 26% negative and 25% positive. Three good and three bad comments are provided below:

+ *Very good driver – Māori very good*
+ *Can't help traffic – bus driver always polite, smiles and says hi/goodbye. 5.10 bus on Riddiford*
+ *The bus driver on the inbound 23 at 7.30am is lovely and should ask the lady he flirts with every morning to go on a date*
– *Many bus drivers are very rude! Many don't allow older people to sit down before driving off. Fix it!!*
– *This has been positive. Sometimes bus drivers are very rude, especially to kids.*
– *Driver smelled of booze*

For Auckland, 24 (30%) adverse driver comments were made compared with 17 (21%) generally satisfied comments. Thus the ratio of good to bad was lower than for Christchurch or Wellington. Three good and three bad comments are listed below.

+ *Bus driver is very friendly and welcome. Best driver I have seen in 7 years*
+ *Bus driver is an awesome guy! Friendly too! Bus comes on time and it leaves James Street on time every day. He is the best*
+ *The Birkenhead bus drivers are all very friendly – more so than the one on mix buses in town – cheers*
– *Some drivers are nuts and take right off and cut off bikes*
– *A lot of bus drivers leave their braking till the last minute before they stop*
– *The bus driver needs to not be angry. Very bad customer service killed my bus ride*

By comparison far fewer comments were made about guards on trains. For Auckland, only five comments were made of which four were adverse comments and one was good. One woman commented: 'I am pregnant and train staff used to be helpful when they had tickets, they would wait. Now they see you coming and still close the doors'.

For buses, several of the vehicle quality comments mentioned graffiti or cleanliness. Others mentioned lack of leg room, advertising on windows and air conditioning.

Five times as many comments were made about the quality of the trains than the buses. Twenty-two adverse comments were made by Auckland rail respondents with several mentioning the age of the trains and the urgent need for the new electric stock to be introduced. Four comments were made by Wellington rail users.

Fourteen comments mentioned a bumpy ride. Six comments were made by Christchurch respondents about the roads which had been badly affected by the earthquake

Twelve comments were made about a lack of seating, four each from bus users in Christchurch, Wellington and Auckland and eight from Auckland train respondents.

Twenty comments were made about noisy buses or trains with half of them made by Auckland rail passengers.

Twelve comments were made about the quality of the seating with some tall passengers mentioning a lack of leg room.

The number of respondents mentioning air conditioning reflected when the surveys were done. All the comments were made by Auckland respondents who were surveyed in high summer. None were made by Christchurch or Wellington respondents who were surveyed in late spring/early summer.

A few comments were made about space for bicycles and luggage.

Example comments on bus quality

Christchurch

Nice, pity about graffiti though

No leg room for tall people

Wellington

Great view window (esp. for tourists). Keep ads off them!

The electric buses are great but need a bit of a spruce up

Travel time is important to me, hence I catch the 91 Flyer rather than catch an 83 that stops everywhere between the Hutt Valley and Wellington. I think that the Flyer is about twice the price of the 83 (ouch) but in the mornings, travel time is the deciding factor. The 91 Flyer is costly and does advertise itself as first class with air-conditioned comfort; I do think that they should honour that and clean the inside of their buses and get their air-conditioning fixed immediately. It is not acceptable to expect passengers to be stuck in the stifling heat without the ability to open a sunroof or window when the 'automatic' air-conditioning breaks down. Thanks for the opportunity to respond (questionnaire emailed).

The new Matangi trains have very inadequate shoulder room

Still should have purchased Hillsborough NZ made

Auckland

Music, better seats, more or less you should be able to realize what you can do better

Buses don’t have windows, so rely on air conditioning, but it is never on, and I catch bus daily, when full, it gets very hot

Sorry, trains are just not enjoyable in Auckland

Old trains are scary. Don’t look nice. They smell and always afraid to get on

Stations great!! Trains average, get it sorted.

Need electronic trains sooner, the diesels are too old

When are the new trains coming? $20 penalty fare over the top and I always pay!!

Example comments on noisy buses and trains

Wellington bus

Buses are so noisy when they open doors. I hate this

Auckland bus

The buses are so noisy, bumpy, seats are so tight, can only place one bag on lap

Wellington rail

Please make the trains quieter

Noise from electrical equipment on roof is annoying

Auckland rail

The trains are smelly and noisy. Onehunga station is popular there is no shelter for tagging off. We need a long station shelter and easier exiting from car park

I hope new electric trains will be quieter

As my experience, train station and staff most of the time are clean, helpful, however train is still noisy during the travel

Example comments on bumpy ride

Christchurch bus

Please hurry to get the road fixed, they are very rough. I appreciate the driver's kindness

Rarely use the bus, car broken down, but this is super bumpy

The rough roads are due to the earthquakes

Wellington bus

The Scania buses are very rough to ride in. Don't make for a pleasant riding journey

Wellington rail

Normally this service has a smooth ride but this carriage on the 1255 service 5 Dec appears to have imbalanced wheels. Lots of vibration

Auckland bus

The buses are so noisy, bumpy, seats are so tight, can only place one bag on lap

Auckland rail

Trains are all right, just need to be bigger, smoother.

8.6 Bus stop and train station quality comments

Of the 92 comments on station quality, over 70% were by Auckland respondents; 38 were about bus stop or train station shelter, 27 about electronic information boards and 12 about announcements or information in general. Seven Auckland rail users made comments about toilets and four about car parks.

Table 8.5 Bus stop and train station comments

Stop/station quality comments	Number of comments						Percent of total comments					
	Bus			Rail			Bus			Rail		Total
	CHC	WTN	AUC	WTN	AUC	Total	CHC	WTN	AUC	WTN	AUC	
Bus stop shelter/station issues	9	7	8	2	12	38	100%	47%	30%	67%	32%	41%
Not enough car parks	0	0	0	0	4	4	0%	0%	0%	0%	11%	4%
Announcements/ information	0	0	3	1	12	16	0%	0%	11%	33%	32%	17%
Toilets	0	0	0	0	7	7	0%	0%	0%	0%	18%	8%
Electronic information boards	0	8	16	0	3	27	0%	53%	59%	0%	8%	29%
Total stop/station quality	9	15	27	3	38	92	18%	24%	34%	33%	63%	35%

A range of comments were made, mostly about the absence of shelter at bus stops and train stations or the inability to see buses from inside the shelter.

Comments on Christchurch bus stop quality

I hate this as I have to connect to another bus and I am very unhappy about the state of other shelters and buses

Christchurch needs more sheltered bus stops. More electronic timetables would be great too :)

Bus stop for hospital + patients arriving, have to walk 300m, could easily put stop outside

Comments on Wellington bus stop quality

Lots of the bus stops you can be waiting inside out of the rain and not be seen by the driver. The Adshiel sign blocking your sight outside Arty Bees Manners Street

The bus stops in suburbs are not at all weather protected against strong winds and cold. Also real time info is not available at every stop

I normally get on at Rintoul St but there is no shelter there anymore so I walked to Newtown as it was raining

Comments on Auckland bus stop and train station quality

Bus

Smells like something died at my bus stop, has done for months

Better signage for bus stops"

Rail

The trains are smelly and noisy. Onehunga station is popular there is no shelter for tagging off. We need a long station shelter and easier exiting from car park

The condition of Remuera station is very good. I gave an average score. Could give more shelter and seating. Trains- main issue is not enough seats, standing room only at leave from Ellerslie to Britomart

It would be great to have additional car park lighting at Manurewa. Also it would be nice if coffee vendors could operate by stations. More rain protection needed in winter. Wifi on trains would be useful too

The trains need upgrading and better lighting on walkway of Baldwin Ave because at night it's pitch black

8.7 Service frequency

Comments coded under frequency usually asked for more buses or trains and of the 38 received, 31 were made by Auckland respondents. A handful of comments, all by Aucklanders, were about the weekend timetable.

Table 8.6 Bus stop and train station comments

Frequency	Number of comments						Percent of total comments					
	Bus			Rail		Total	Bus			Rail		Total
	CHC	WTN	AUC	WTN	AUC		CHC	WTN	AUC	WTN	AUC	
More buses or trains	3	4	20	0	11	38	100%	100%	87%	na	79%	86%
Weekend timetable	0	0	3	0	3	6	0%	0%	13%	na	21%	14%
Total	3	4	23	0	14	44	27%	18%	36%	0%	38%	33%

The selection of comments provided below shows some overlap with 'lack of seats'.

Christchurch

More frequent buses and a whole social change in the way we view them is needed – not just for poor people

Wellington

I would really appreciate a number 10 from the Zoo around 8:25 in the mornings

Auckland bus

Add more buses till late nights, so don't have to spend on taxi. Thank you

My main issue is the lack of frequent buses out west

Buses drivers are fine, but there are not enough for my area and there are no options after 7:00 pm

Auckland rail

The train is full and over crowed in morning with all the kids catching early trains as well. Please put more carriages on or more frequently

Trains do not run often enough to south Auckland from New Market

8.8 Journey time – speed of service

Only 15 comments were made about the journey time being too long or the service too slow or that there was too much traffic for buses. Twelve of the 15 comments were made by Auckland respondents. One comment each was made by Christchurch bus, Wellington bus and Wellington train users.

Table 8.7 Bus stop and train station comments

Journey time	Number of comments						Percent of total comments					
	Bus			Rail			Bus			Rail		
	CHC	WTN	AUC	WTN	AUC	Total	CHC	WTN	AUC	WTN	AUC	Total
Buses/trains too slow	1	1	5	1	4	12	8%	4%	7%	50%	10%	8%
Too much traffic for buses	0	0	3	0	0	3	0%	0%	4%	0%	0%	2%
Total	1	1	8	1	4	15	8%	4%	11%	50%	10%	10%

Comments on journey time

Christchurch

Its long taking bus rides to where I need to go

Wellington bus

Some buses are very old, and are noisy, smell and breakdown. They are also very slow up hills

Auckland bus

Auckland needs more bus lanes

Auckland rail

Need express trains. It takes too long. It is a 20 min drive and 1hr train

We need an express train during peak hours. Train takes too long to get to city

8.9 Price – the cost of using bus and train

Thirty-two comments were made about price. Fifteen were made in Auckland, 13 in Wellington and four in Christchurch. The comments focused on wanting cheaper fares or saying the fares were too expensive.

Table 8.8 Bus stop and train station comments

Fares	Number of comments					
	Bus			Rail		Total
	CHC	WTN	AUC	WTN	AUC	
Cheaper fares/too expensive	4	13	10	0	5	32

Comments on price – the cost of using bus and train

Christchurch

Please make it cheaper

No one wants more expensive buses, I wouldn't be able to afford it

It's getting expensive to use buses

Wellington bus

Price was high (2 sections) but very short trip (10 mins walk) public transport is expensive compared to car ownership in NZ

Too expensive for average income earned over a week. Question 22B

Auckland bus

I would catch the bus if it was cheaper than driving and parking, then a short ride in bus just too expensive when you live in west Auckland- could be cheaper

The express service is great, but prices should be reduced

Flat rates for low income people if not at all. In China, bus fare is very affordable. Only 20 NZ cents

Auckland rail

The trains are really expensive

More trains and cheaper tickets

The trains are so expensive

8.10 Ticketing issues

In Auckland, ticketing was a significant issue with the HOP card having just been introduced to the rail system. A total of 67 comments were made by rail passengers. By contrast, on Auckland buses and in Christchurch and Wellington, ticketing issues were rarely mentioned.

Table 8.9 Bus stop and train station comments

Ticketing issues	Number of comments						Percent of comments					
	Bus			Rail		Total	Bus			Rail		Total
	CHC	WTN	AUC	WTN	AUC		CHC	WTN	AUC	WTN	AUC	
Electronic/std ticketing issues	3	6	18	0	64	91	100%	100%	100%	na	96%	97%
Electronic tag on/off issues	0	0	0	0	3	3	0%	0%	0%	na	4%	3%
Total	3	6	18	0	67	94	100%	100%	100%	na	100%	100%

Auckland rail passengers requested more ticketing machines at stations and an ability to buy tickets on board. A few commented they had missed their train because it had been difficult to buy a ticket. More places to tag on and tag off their journey details were also asked for.

Auckland rail problems buying tickets

New train ticket AT HOP card is absolutely shocking system, there are not enough ticket machines at any station

Many more paper purchase stations to buy tickets. One not enough

All the stations need more ticket machines

Difficult to purchase ticket in a hurry at machine

The purchase of tickets at the station was queued and made several people miss two trains

Other Auckland rail comments on electronic ticketing:

Why is there only 1 tag off pole at New Lynn station at the more busy side and 2 at the other side

Greenlane station would benefit from at least one more card reader

Need to improve system, maybe use HOP bus system

Being able to pay on the train would be fantastic. Especially if running for trains

HOP card on Ritchie's buses would be great

AT hop card should be free

8.11 Reliability

More comments were made about reliability than any other issue with 231 (20%) in total. Of these, 94% were reliability/timetabling issues with the remaining 6% about cancelled services, buses arriving at the same time or not arriving at all.

Table 8.10 Bus stop and train station comments

Reliability	Number of comments						Percent of comments					
	Bus			Rail		Total	Bus			Rail		Total
	CHC	WTN	AUC	WTN	AUC		CHC	WTN	AUC	WTN	AUC	
General reliability	22	29	106	9	50	216	100%	94%	96%	100%	85%	94%
Cancelled service	0	1	0	0	7	8	0%	3%	0%	0%	12%	3%
Arrive at the same time	0	1	0	0	0	1	0%	3%	0%	0%	0%	0%
Service did not arrive	0	0	4	0	2	6	0%	0%	4%	0%	3%	3%
Total	22	31	110	9	59	231	100%	100%	100%	100%	100%	100%

Comments on Christchurch bus reliability

Orbiter changes affected by road works

Bus pretty good, just usually late at the bank, plus the road is nightmare, but what can you do?

#5 doesn't follow the timetable, always late

Comments on Wellington bus and train reliability

Bus

Frequent delays encourage me to use alternatives. Texts re delays sometimes arrive after the train

I find the bus service from Karori really good except going from town to Karori between 8 and 10pm is unreliable.

Northland to city service always tends to run late. Electronic signs are good but sometimes buses disappear off them.

Rail

The service WN to Wairarapa leaving WN 5.30pm has been late for the last week. Very poor service.

What is the point? Just ask what is important. Besides on this line the train rarely goes on time.

Comments on Auckland bus and train reliability

Bus

Why don't you focus on the reliability of services rather than worrying about lighting, emissions, on bus info, etc?!!. And ask us questions in mornings! :)

334 from Massey road to Otahuhu always comes late and always get late for my job. Please do something about it.

My bus from work is really bad. Often late]... It sometimes doesn't come at all. Not good!

All I know I have been waiting for one hour and half. They have put the time never come out.

Was disappointed that the 283 bus to the hospital did not arrive-- it is very important that I get to the hospital

Rail

Trains very unreliable- too many breakdowns, the fare is too expensive as well and the platform is open so no shelter

Frequent traveller, generally good service, only problem if train is cancelled, not enough information given and train seems to be rarely replaced by bus

The punctuality is bad. I have experienced delays many times. Delays mean for me to miss the ferry. A few times I spent 40min on the train from Ellerslie to Britomart

Trains could be a lot more reliable. Cancelled and delayed trains due to no train drivers really is unacceptable

8.12 Other comments

Out of the 67 ‘other’ comments, 48 were by Auckland respondents. Some were explanations about their trip such as it was just one ‘leg’ of their trip, or that they were a visitor (with some visitors adding they did not know the transport system well enough to comment). Other comments covered pets on buses, food, issues for disabled travellers, changes to services, public transport investment in general and the integration of companies as (see table 8.11). Some examples are provided for Christchurch, Wellington and Auckland.

Table 8.11 Other comments

Other issues	Number of comments						Percent of comments					
	Bus			Rail		Total	Bus			Rail		Total
	CHC	WTN	AUC	WTN	AUC		CHC	WTN	AUC	WTN	AUC	
Miscellaneous comments	0	0	4	0	11	15	0%	0%	18%	na	42%	22%
Other passengers	1	2	3	0	4	10	14%	17%	14%	na	15%	15%
Pets on buses	0	1	0	0	0	1	0%	8%	0%	na	0%	1%
Food on vehicles etc	0	1	0	0	0	1	0%	8%	0%	na	0%	1%
Disabled traveller issues	0	0	2	0	1	3	0%	0%	9%	na	4%	4%
Changes to services	4	1	1	0	1	7	57%	8%	5%	na	4%	10%
More public transport investment/environmental	0	2	3	0	3	8	0%	17%	14%	na	12%	12%
Integration of companies etc	0	0	4	0	3	7	0%	0%	18%	na	12%	10%
Other	2	5	5	0	3	15	29%	42%	23%	na	12%	22%
Total	7	12	22	0	26	67	100%	100%	100%	na	100%	100%

Other comments by Christchurch bus respondents

There isn't anything majorly wrong except everyone complaining about the new timetable/ route or something

This is the Orbiter connection part of a longer route I take

The more immature girls I have to put up with in the morning make it !^%!

Other comments by Wellington bus and rail respondents

Should be able to take pets on buses

When it comes to bus stop and bus quality, I have noticed that socioeconomic status has a lot to do with whether a bus/bus stop is bad/ill-treated.

More money spent on public transport. Less on motorways please.

(Rail) *There's a lock on the WI-FI should be a password*

Other comments by Auckland bus and rail respondents

Bus

Integrate more seamlessly with Google maps

I don't like the high school kids came on the bus-they are loud and noisy.

You need to do something about this system, build a metro system!

Rail

Disabled parking not clear, only found in 180min, also on wrong side of the station

Very annoying, music on trains by passengers.

Train service ok, but why can't I get to the airport like the most of other cities?

Some passengers are quite arrogant toward mums with prams, maybe widen the lanes? Overall good experience

8.13 Comments expressing general satisfaction

Of the 265 'generally satisfied' comments, 101 were by Auckland bus passengers, 89 by Auckland rail passengers, 39 by Wellington bus passengers and 36 by Christchurch passengers. Taking account of the numbers of returned questionnaires as section 8.4 showed, Auckland rail respondents were the most likely to express satisfaction and Wellington bus users the least.

Table 8.12 Generally satisfied comments

Complimentary remarks	Number of comments					
	Bus			Rail		Total
	CHC	WTN	AUC	WTN	AUC	
Good/very good/average	36	39	101	0	89	265

Some comments started or finished by expressing satisfaction, but made critical observations too as some of the following examples show.

General satisfaction comments by Christchurch bus respondents

Bus service in Christchurch is marvellous; some of the driver could be more courteous waiting for elderly passengers to sit down especially to smile occasionally

Until the earthquake, I took 21 almost daily, and found the service, driver excellent, I work from home and returned in June 2012

No.3 bus-airport to Sumner, great service, always on time

I only use the bus occasionally for shopping or hospital visits and I am very grateful I can leave car in Hornsby and take a bus making it so much easier stress. Thank you

Polite service, friendly environment, enjoyable service

General satisfaction comments by Wellington bus respondents

Very good bus service (better than Auckland bus service). I'm from Auckland

Overall good service and entertaining about survey as I get to do something while on bus

Christchurch fare system is the best. People are prepared to use buses frequently must be rewarded with a good deal

General satisfaction comments by Auckland bus and rail respondents

Bus

Apart from the difficulty of writing on a moving bus, I am very pleased with the services presented

Enjoying Auckland via bus transport

The bus service is really good. Drivers are quite friendly. Thank you

Service is average - could be better but I do get to my destination in one piece so thank you!

Rail

The transport service offered is reasonably great without the service I wouldn't be able to go places when I want to

Loving taking the trains to work it is a lot easier than taking my car

Train facilities have greatly improved. I believe however newer trains and more seats would be helpful especially for peak hour, I often end up standing

It is a great to and from service; however the tickets are not exactly clear on how to buy them for foreigners or oversea visitor

8.14 Comments about the questionnaire

Thirty-eight comments were made about the questionnaire with a reasonably equal spread across the cities and between rail and bus. Some were no more than a 'hope I helped' or 'I'd like to do the internet survey'. Others wanted to know what the survey was for. Several explained their response to the ratings which in most cases was about leaving the response boxes blank. Others made comments about how their trip affected their response or about factors that were not included in the ratings, primarily reliability. A few complained about the wording of the rating questions or about the choices in the SP exercise (such as being too extreme) and some made complimentary remarks about the questionnaire or surveyors.

Table 8.13 Comments about questionnaire

Questionnaire comments	Number of comments					
	Bus			Rail		Total
	CHC	WTN	AUC	WTN	AUC	
Comments about survey	9	12	5	6	6	38

Comments on questionnaire

Christchurch

If I have more time, I really like to get more input in this survey

Answers to questions vary according to time of day, road works etc, congestion in [particular road] sometimes bad

Wellington bus

Blanks in ratings indicate haven't used attribute

This survey annoys me! How can you decide between 5 and 6? Bus service is good

Wellington rail

Questionnaire should address frequency of delays as a rating question

I often DON'T love Matangi trains in morning-> ratings would be completely different! i.e. worse

Auckland rail

The questionnaire has some poorly worded questions. E.g., availability and cleanliness are different concepts, as are availability and comfort

Auckland bus

Very nice surveyor

Good for you for asking your customers. More please

8.15 Email address

A total of 922 respondents gave their email addresses. Over half (53%) of the email addresses were from Auckland respondents, 41% were from Wellington and only 7% from Christchurch. This provides scope to do future work (eg to track changes in attribute ratings over time) with a sample of several hundred public transport users, particularly in Auckland and Wellington.

8.16 Conclusions

The opportunity provided on the rating questionnaire to 'volunteer' comments generated over 1,100 responses with a similar percentage of respondents providing their email address and offering to take part in further survey work.

The opportunity to comment was given at the end of the questionnaire with no instructions on how to respond. Two-thirds made a complaint or offered a suggestion and a third expressed satisfaction. Given there were no instructions or guidance about what to comment on, responses did provide an indication of the strength of opinion; however they will have been 'coloured' by the focus and content of the questionnaire.

A third of Auckland rail users made a comment compared with a quarter of Christchurch bus users. By contrast, only 1 in 10 Wellington bus users made a comment.

Comments about vehicle quality were the most frequent of attributes included in the survey, with most about the overall standard of the vehicle followed by comments about the driver or train staff. Comments about the quality of the bus stop or train station were next, albeit half that of vehicle quality. Clearly, as the rating survey focused on vehicle and stop quality, the orientation of the comments was not unexpected. There were fewer comments about journey time, price and frequency.

More comments (around 20%) were about service reliability which was deliberately not included on the questionnaire. Typical comments most often made by Auckland rail users were that services were late, early or did not arrive at all.

Eight percent of comments were about ticketing with two-thirds made by Auckland rail users, which reflected 'teething' problems with the electronic ticketing system.

No comments were made specifically about personal safety or security other than a few comments about station lighting.

Nine hundred bus and train users provided their email address, indicating a willingness to participate in further transport research which could be used to monitor attitudinal changes over time for a panel of users or perhaps to study additional attributes such as interchange, reliability or crowding using a SP internet survey.

9 Conclusions and recommendations

9.1 Survey method

The survey involved two questionnaires: a rating survey completed by 7,201 passengers (57% of the total); and a stated preference (SP) survey completed by 5,356 passengers (43%).

The use of a 'hybrid' approach combining a rating questionnaire with a SP questionnaire was new. The literature review (published separately as part 2 of this report) found no similar approach; the closest was a system-wide study of Sydney rail users undertaken in the mid-2000s which used a rating survey and a 'what if' questionnaire to derive valuations rather than a SP survey (Douglas and Karpouzis 2006a). Most of the studies reviewed valued individual attributes such as 'no steps versus one boarding step' then constructed 'package' values. In doing so, the resultant package values were often large and required downwards adjustment. However, in this study the use of ratings allowed attributes to be valued in a continuous way without any downward adjustments to the package values.

The hybrid rating/SP approach was piloted in Wellington in November 2012. The rating survey worked well as a self-completion questionnaire. The first SP surveys were conducted by interviewers but as it was difficult to interview on moving buses the questionnaire was rewritten as a self-completion questionnaire; this worked well and provided the added bonus of a sample three times larger than targetted.

The survey covered contracted urban bus and train services, longer-distance rail services (Wairarapa and Auckland–Pukekohe) and outer Christchurch bus services, as well as the Wellington Airport Flyer which operates without subsidy and offers a premium bus service at higher fares. Altogether, services operated by 15 bus companies and two rail operators were surveyed.

Besides vehicle and stop/station quality, the study covered service frequency, time spent on the bus or train (IVT) and fare. Frequency, time and fare enabled changes in the vehicle quality and stop/station quality ratings to be valued in minutes and dollars as well as estimating values of time under different conditions.

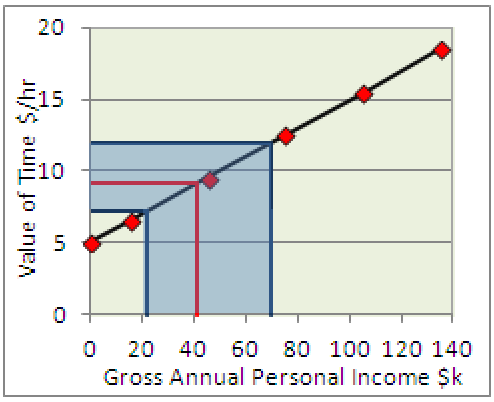
9.2 Value of in-vehicle time

The value of in-vehicle time (IVT) was estimated at $9.09 per hour which was 50% higher than a figure of $6/hour in the EEM that derives from similar market research surveys undertaken in 2001.

As well as providing a 'basic' value of time, the study was able to quantify the effect of vehicle quality on the value of time. Respondents were willing to pay $5.40 to save an hour travelling on a very poor quality vehicle than on a very good one.

Another feature of the research was to standardise the values for income. Passengers with higher incomes were more willing to pay to save time than passengers on low incomes. At a notional zero annual income, the value of time was $5/hour and increased to $18.50/hour for passengers earning $135,000 per year. Across the bus and train routes surveyed, average incomes ranged from $22,000 to $70,000 a year with the predicted value of time ranging from $7.20 to $12/hour, the blue shaded area in figure 9.1. The survey results were standardised at the average income of $40,800 but can be re-positioned at any income level. Standardisation enables economic evaluations (where 'spatial equity' is important) to avoid biasing investment towards wealthier areas.

Figure 9.1 Value of in-vehicle time with personal income



For demand forecasts, behavioural rather than equity values are needed and to this end, the researched parameter values can be reset at any income level. To assist, the passenger profile of 43 aggregated bus and rail routes in Auckland, Christchurch and Wellington for peak and off-peak travel was assessed. An updating index was also developed to uplift the valuations for future growth in average incomes. Furthermore, an updating index is provided to uplift the valuations for future growth in average income. The updating method proposed is an alternative to the consumer price index which the Transport Agency has used.

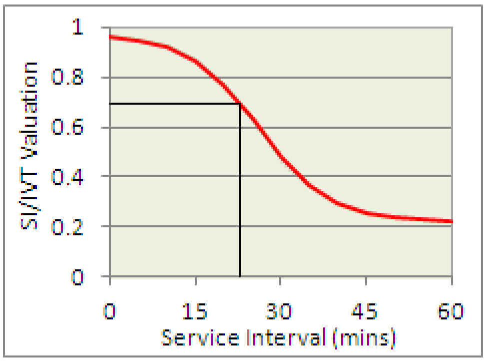
9.3 Value of service interval

The survey covered low and high frequency services in the peak, off-peak, evening and weekends. By asking passengers about wait times as well as the service interval (minutes between departures), the study was able to estimate a mathematical relationship between frequency and waiting time.

In terms of willingness to pay for more frequent services, analysis of passenger response concluded that a curvilinear function provided the best-fit as shown in figure 9.2. For high frequency services (when most passengers turn up 'at random' rather than consult a timetable and typically wait half the headway), a minute of service interval was valued nearly the same as a minute spent on the bus or train. Thus the valuation was close to the conventional assumption of valuing wait time twice that of IVT.

The valuation was lower for less frequent services, so that for an hourly service the SI/IVT valuation was only 0.2; this lower value probably reflects the alternative uses for service interval 'time' in the home, office or pub. At the average service interval of 23 minutes, the relative valuation was 0.7 which was close to the ATC (2006) guideline figure of 0.72 although higher than the 0.63 ratio in the EEM.

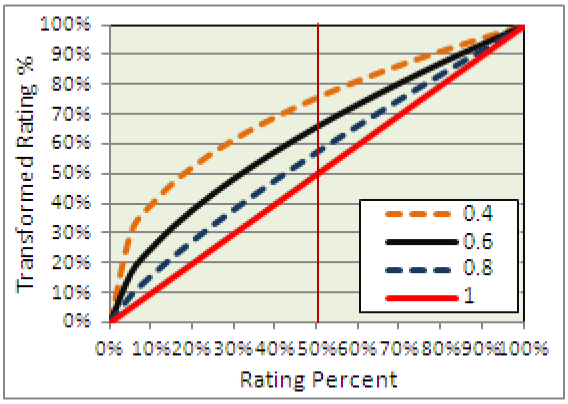
Figure 9.2 Curvilinear service interval function



9.4 Value of vehicle and stop/station quality

Passengers were more sensitive to poor than good quality and to accommodate this 'diminishing marginal value of quality', a power function with values ranging from 0 to 1 was fitted to the data as shown in figure 9.3. Values of 0.65 for vehicle quality and 0.7 for stop quality best fit the data. For vehicle quality, an average quality rating of 50% was transformed to 64% which widened the quality gap to very poor (0%) but narrowed the gap to very good (100%). In this way, the maximum willingness to pay for quality (0% to 100%) was weighted more to poor quality than to good quality.

Figure 9.3 Transformation of quality rating using a power function



The rating questionnaire asked respondents to rate their vehicle (bus or train) and the stop/station where they boarded in terms of a list of attributes on a 1 to 9 scale with 1 being very poor and 9 very good. Two types of model were then estimated on the data. First, the respondent's overall rating was explained in terms of the characteristics of the vehicle or stop and the profile of the passenger. Second, the variation in the overall ratings was explained in terms of the variation in the individual attribute ratings to attempt to determine the relative importance of the attributes. The large sample sizes meant that the parameters in both models could be estimated with high statistical accuracy.

9.5 Stated preference survey

A series of pair-wise journey choices were presented in the SP survey in which the travel time, frequency, fare, vehicle quality and stop quality were varied. To cater for the different trip lengths, fares and frequencies of the bus and train services in the three cities, 22 variants of the questionnaire were designed.

A five-star system (similar to that used for films and restaurants) was used with descriptions of stop/ station and bus/train quality. One star indicated very poor; two poor; three average; four good and five very good. Partly to familiarise respondents with the star system, passengers were first asked to rate their vehicle and the stop/station where they boarded.

After transforming the five-point and nine-point rating scales onto the same percentage scale (0% very poor, 50% average and 100% very good) the two surveys were found to give identical 70% vehicle ratings for bus with only a 2% difference for trains at 74% rating and 76% SP.

On average, each of the 5,356 respondents who completed a questionnaire provided 7.4 responses which gave 39,865 SP observations in total. The large sample size enabled the effect of gender, trip purpose, age group, income, trip length, mode and city on the values of time and quality to be determined with a high degree of statistical accuracy.

9.6 Profile of bus and rail users

In combination, the two surveys presented a snap-shot picture of urban bus and rail transport in the three main centres of New Zealand in 2012/13. The profile of bus and rail users (gender, trip purpose, age group, income, ticket type, fare paid, frequency of public transport use, trip length, service interval, wait time and rail access mode) was tabulated by aggregated route, aggregated bus stop and rail station for peak and off-peak travel.

9.7 Analysis of bus and train quality

The rating survey provided passengers' opinion of the quality of the bus or train and also of the bus stop or train stations they were using when surveyed. For vehicles, a descriptive analysis was undertaken for 43 aggregated bus and train routes. The average vehicle rating across the 43 'aggregated' routes was 71%.

The two routes that achieved the highest ratings were the Outer Loop bus service in Auckland (83%) and the Johnsonville rail line in Wellington (82%). Both routes used new vehicles less than a year old. The lowest-rated bus route was the Far South Papakura (400s) service in Auckland which scored 63% and the lowest-rated rail route was the East Line in Auckland at 64%. Both routes used relatively old buses and trains. Thus the range in vehicle rating was 20% and when valued using the SP results, the difference was equivalent to 2.4 minutes of IVT or 8% of the $4 average fare.

The vehicle ratings were related to the characteristics of the buses and trains using data provided by Auckland Transport, Environment Canterbury and Greater Wellington Regional Council (vehicle make, age, seat capacity, Euro engine rating, air conditioning and whether the bus was low floor, wheel chair accessible and had a bike rack). A total of 35 different vehicle types were surveyed: 28 buses and seven trains.

The highest-rated vehicle was the new Matangi train which scored 82% overall. The Matangi had been introduced in Wellington the previous year and came top in seven attributes and second in four. Only in terms of staff (which was not a vehicle type attribute), did the Matangi rank below second. The ex-British Rail loco-hauled carriages used on the longer distance Wairarapa line scored 78% overall. At 59%, the older Ganz Mavag Wellington electric multiple units (averaging 30 years in service scored the lowest rating of the train types surveyed). The four Auckland diesel powered trains (which were programmed to be replaced with electric stock) rated around 68%.

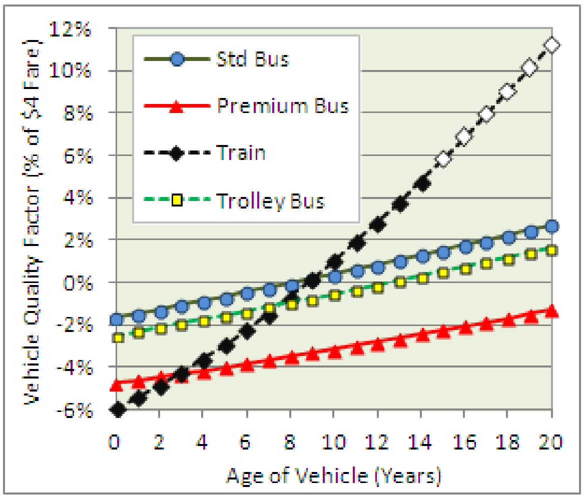
Five bus types dominated the survey with each type surveyed over 900 times: Alexander Dennis (ADL) the MAN11, MAN12, MAN17 and Scania. The MAN11 buses were the oldest averaging 15 years in service and scored 66%. The MAN12 and MAN17 were younger at 10 and eight years old respectively and scored 66%. The Scania buses (used on the Wellington Airport Flyer have next stop display, automatic announcements, leather seats and bag storage facilities) were also younger, averaging four years in service and scored 74%.

The vehicle type data and passenger profile data was used to explain the ratings using linear (easiest to interpret) and 'S' shaped 'logit' models (constrained forecasts to between 0% and 100%). Bus ratings tended to increase with seat capacity from 70% for a 25-seat midi bus to 72% for a standard 42-seat bus to 75% for a 72-seat articulated bus. In terms of vehicle type, a new electric trolley bus rated 2.7% higher and a premium service (Auckland Loop or the Wellington Airport Flyer) rated 6.7% higher than the average bus.

As bus and trains aged, their rating declined. The decline was steeper (1.88% pa) for trains than buses (0.44% pa), although train age was measured from 'last refurbishment' compared with 'new' for buses.

The SP valued the vehicle ratings. Passengers were willing to pay 5.9% higher fares for a new train and 4.7% higher fares for a new 'premium' bus service than an eight year old bus. For a new trolley bus, the willingness to pay was 2.5%. As vehicles aged, willingness to pay declined so that after three years, trains were valued the same as a premium bus and after nine years, the same as a standard bus.

Figure 9.4 Vehicle quality cost (fare %) with vehicle age



Analysis of the responses also revealed that females tended to rate their vehicle 1.6% higher than males, retired passengers 5.5% higher than non-retired passengers, and young respondents (less than 18 years old) 3.5% lower.

The second strand of analysis determined the relative importance of attributes. *Ride quality* and *staff* were the two most important attributes accounting for 14% of the total rating. *Vehicle outside appearance* was third on 13%. *Seat availability and comfort* on 12% and *environmental impact* (noise and emissions) on 10% were ranked 4th and 5th in importance. Of middling importance (at 6%–8% each) were inside *cleanliness and graffiti*, *ease of getting on and off*, *heating and air conditioning* and *onboard information and announcements*.

Table 9.1 Vehicle attribute importance and rating

Attribute	Importance	Rating
1 Smoothness & Quietness	14%	64%
2 Driver/Staff	14%	73%
3 Outside Appearance	13%	72%
4 Seat Availability & Comfort	12%	74%
5 Environmental Impact	10%	62%
6 Inside Cleanliness & Graffiti	8%	75%
7 Ease of On & Off	7%	77%
8 Heating & Air Conditioning	7%	69%
9 Info. & Announcements	6%	64%
10 Space for Bags	4%	66%
11 Lighting	2%	75%
12 Toilet Avail. & Cleanliness	2%	76%
13 Computer & Internet (WIFI)	1%	41%
Overall Rating	100%	72%

The least important attributes were space for personal belongings, lighting, toilet availability/cleanliness and ‘ability to use your computer and connect to the internet (wifi)’ with each attribute explaining less than 5% of the overall rating.

Determining the relative importance of the vehicle attributes enabled the willingness-to-pay valuations to be ‘unpacked’. Some worked examples were presented to show how the effect of a particular attribute could be valued. One example, using the environmental rating, was converting a diesel bus (pre Euro engine standard) to an electric trolley bus. Willingness to pay, based on a predicted a 3.4% rating increase was a 1.5% fare increase.

The model was extended to look at how trip and socio-demographic characteristics affected attribute importance. Ten ‘interactions’ were statistically significant. *Toilet availability and cleanliness* was important for trips over 40 minutes but unimportant for shorter trips. Females placed more importance on *cleanliness* and less importance on the *environment* than males. Retired passengers attached more importance to *seat availability and comfort* and less on the *environment*.

Table 9.2 Vehicle attribute importance by market segment

Attribute	Market Segment	Effect
Toilet Avail & Cleanliness	Trips > 40 mins	+
Environment	Females	-
" " "	Retired Passengers	-
" " "	Entertainment/Hol. Trips	+
" " "	Visit Friends/Rels Trips	-
Inside Cleanliness & Graffiti	Females	+
Outside Veh. Appearance	18-25 year olds	-
Seat Avail. & Comfort	Retired Passengers	+
" " " "	Under 18 year olds	-
" " " "	Visit Friends/Rels Trips	+
Legend: + More important - Less important		

Passengers visiting friends or relatives attached more importance to *seat availability/comfort* and less to the *environment* whereas passengers making entertainment/holiday trips attached more importance to the *environment*. 18–25 year olds attached less importance to the *outside appearance* whereas young respondents (under 18) attached less importance *to seat availability/comfort*.

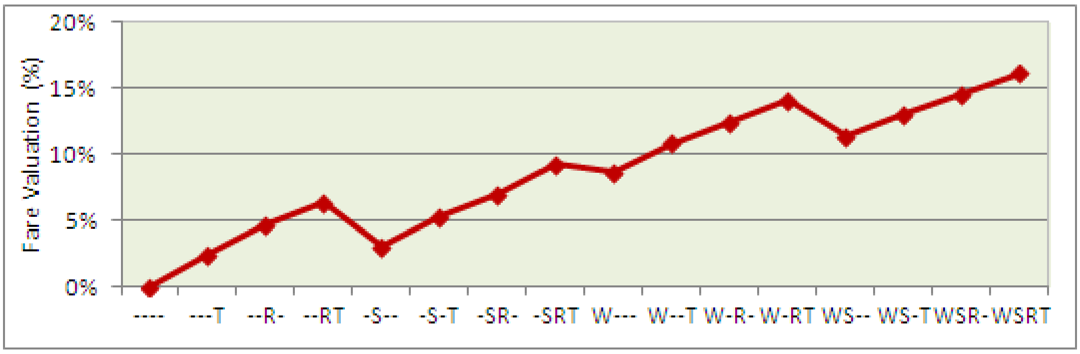
9.8 Bus stop and train station analysis

Similar analysis was applied to the bus stop and rail station ratings. Bus stop ratings had a similar range to vehicles with a low of 60% on South Auckland bus routes and a high of 81% on the Auckland Northern Express Busway (where new stations had been built at Albany and Akoranga). Rail station ratings had a narrower range from 61% on the Hutt Valley line in Wellington to 71% on the Onehunga line in Auckland. In general, Auckland rail stations tended to be rated higher than in Wellington reflecting the recent upgrade programme. However, there were wide variations by train station and also by aggregated bus stop.

9.9 Analysis of bus stop ratings and facility valuations

Hundreds of bus stops were covered by the survey. The number was too high for them to be assessed individually especially given respondents' imprecise details. In anticipation of this, the rating questionnaire asked passengers whether shelter, seats, timetable and RTI were provided. All 16 combinations of facilities were provided (3,349 respondents). A bus stop with no facilities rated at 46%, compared with one with all four facilities at 75%, with the SP survey valuing the willingness to pay at 16% of the fare. Providing shelter was worth 9%, seating 3%, RTI 3% and a timetable 2%.

Figure 9.5 Value of bus stop facilities



Facs	----	---T	--R-	--RT	-S--	-S-T	-SR-	-SRT	W---	W--T	W-R-	W-RT	WS--	WS-T	WSR-	WSRT
Rating	46%	50%	54%	57%	51%	55%	58%	62%	61%	65%	68%	71%	66%	69%	72%	75%
% Fare	0%	2%	5%	6%	3%	5%	7%	9%	9%	11%	12%	14%	11%	13%	15%	16%

In terms of explanatory power, shelter explained 51%, RTI 20%, seating 17% and a timetable 12% of the overall rating. Only retired passengers were significantly different from other passengers, rating their bus stop 5.5% higher. Rainy weather reduced the stop rating by 3.4%. Bus stations rated the highest reflecting the facilities provided. City centre bus stops rated 4.7% lower and suburban bus stops 7.6% lower. The rating also decreased as waiting times increased albeit gradually at 0.3% per minute.

Table 9.3 Overall bus stop rating explanatory model

	Linear		Logit	
Variable	Beta	|t|	Beta	|t|
SHELTER	0.137	12.5	0.599	13.1
SEATING	0.045	3.5	0.189	3.3
TIMETABLE	0.033	2.8	0.148	2.6
RTI	0.054	6.5	0.261	7.5
RETIRED PAX	0.055	5.1	0.229	4.1
RAINING	-0.034	3.3	-0.148	3.2
CITY CENTRE	-0.047	5.6	-0.230	6.1
SUBURBAN	-0.076	9.9	-0.358	10.2
WAIT TIME	-0.003	10.6	-0.015	9.5
CONSTANT	0.536	37.0	0.264	3.6

Table 9.4 Relative importance of bus stop attributes

#	Attribute	Importance	Av. Rating
1	Cleanliness & Graffiti	25%	69%
2	Weather Protection	23%	61%
3	Seating	23%	60%
4	Information on bus times	18%	67%
5	Lighting	10%	59%
Overall Bus Stop Rating		100%	68%

In terms of importance, *cleanliness and graffiti*, *weather protection* and *seating* were the most important explaining around a quarter of the overall bus stop rating each. *Information* explained 18% and *lighting* was least important at 10%.

Retired passengers placed more importance on *weather protection* whereas *information* was more important to younger respondents. Respondents who waited longer than 10 minutes placed more importance on *information* and less on *seating* and *weather protection*.

Table 9.5 Passenger profile and bus stop attribute importance

Attribute	Market Segment	Effect
Weather Protection	Retired Passengers	+
Information	Under 18 year olds	+
Weather Protection	Wait > 10 minutes	-
Seat Avail. & Comfort	Wait > 10 minutes	-
Information	Wait > 10 minutes	+

Legend: + More important - Less important

9.10 Rail station rating analysis and valuation

The rail station ratings varied more than either the bus stop or vehicle ratings. The highest-rated station at 79% was Newmarket in Auckland, which was largely rebuilt in 2010 with lift and escalator access. The lowest-rated station at 25% was Ava in Wellington, a station plagued by graffiti attacks. The rating range of 54% was valued at 30% of the average $4 fare.

The six largest 'hub' stations were rated 12.4% higher than major stations. Smaller local stations, which generally had fewer facilities and were in some cases maintained to a lower standard, were rated 2.9% lower.

Stations upgraded within 10 years of the survey were rated 7.1% higher and those upgraded within five years 10.4% higher. Off-peak respondents rated their station 2.5% higher than peak respondents with retired passengers rating 5.5% higher and house persons 5.3% higher than employed passengers or students. Passengers making entertainment/holiday trips rated 4.2% higher whereas passengers accessing by car rated 2.7% lower than walkers or respondents who accessed by bus.

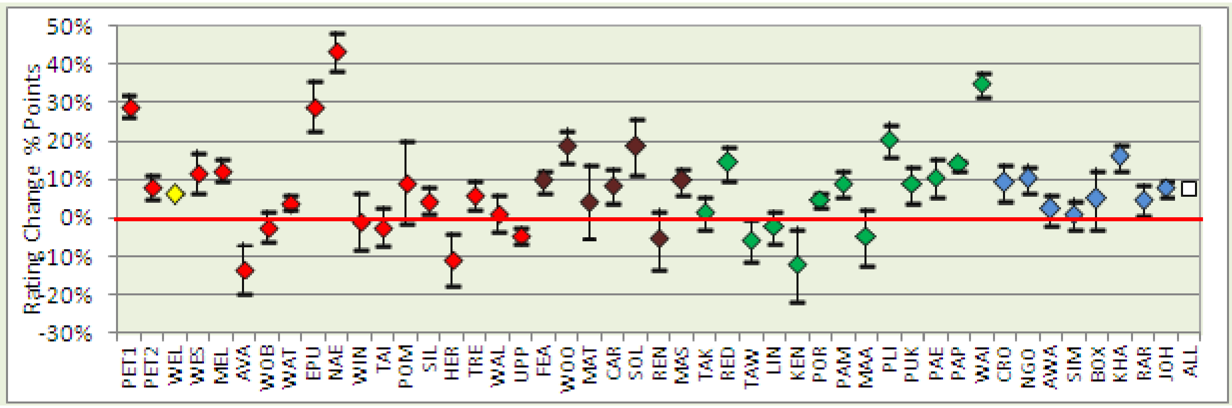
Table 9.6 Overall station rating explanatory model

#		Variable	Linear Beta	Linear |t|	Logit Beta	Logit |t|
14	Full Model	OFFPK	0.025	3.1	0.112	3.8
		ENT/HOL	0.042	3.8	0.199	3.4
		RETIRED	0.055	3.9	0.264	3.4
		HSEPERS	0.053	2.3	0.253	2.0
		CAR&PARK	-0.027	3.1	-0.118	3.1
		HUB	0.124	15.5	0.575	14.7
		LOCAL	-0.029	3.6	-0.121	3.4
		UPG10Y	0.071	7.9	0.317	8.1
		UPG≤5Y	0.033	3.3	0.161	3.6
		CONSTANT	0.561	73.8	0.252	7.2

A comparative 'before and after' analysis of the rail station ratings was undertaken using data collected by Douglas Economics (2005) 10 years previously. There was sufficient response (an additional 5,423 observations) to compare the change in rating (2003–2013) for 45 stations and of these, 10 stations had had major upgrades.

The biggest increase in rating was at Naenae (44%) where the platforms and shelter had been rebuilt. Large increases in rating also occurred at Petone, Epuni and Waikanae where major upgrades had been undertaken. Falls in rating of over 10% occurred at Ava, Heretaunga and Kenepuru where no upgrades had been undertaken.

Figure 9.6 Change in rating (2013–2003) by station



As well as the overall rating, changes in the individual attribute ratings such as *weather protection*, *toilets* were compared according to whether or not the station had been upgraded during the 10-year period. The *weather protection* rating increased 4% with roof renovation and 18% with a major station. For *information*, station upgrading increased the rating by 19%. Upgrading increased the *cleanliness/graffiti* rating by 18.5% and renovation by 11%. *Staff* was not related to station upgrading but did increase by 6% from retail improvements perhaps reflecting the assistance and reassurance provided. In terms of *retail rating*, the opening of cafes and shops at stations led to an increase of 43% and for *ticketing*, the introduction of cafes and shops increased the rating by a third.

There was an 'across the board' 8% increase in the rating of *car parking and passenger set down facilities* with station upgrading increasing the rating by 10%. There was also a greater increase of 19% in the rating of the *'ease of transfer to and from bus'* with station upgrading adding 10%.

The overall rating increased 22.5% from station upgrading; however, the effect dissipated at 2% a year so that after 10 years the effect was fully eroded. Figure 9.7 presents the predicted effect. The willingness to pay for station upgrading was worth 11% of fare ($4) for the first year and 2% for the tenth year after upgrading (an average of 7% over the 10-year period).

Figure 9.7 Effect of a major station upgrade

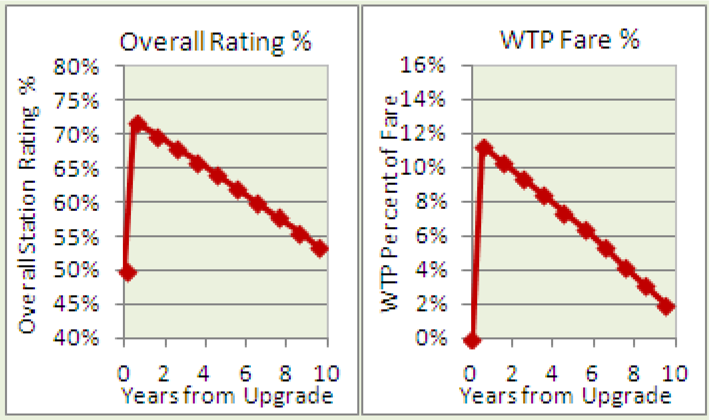


Table 9.7 Relative importance of rail station attributes

#	Variable	Arribute Importance	Average Rating
1	Station Cleanliness & Graffiti	16.9%	56%
2	Weather Protection	12.4%	52%
3	Platform Seating	11.2%	45%
4	Ease of Getting To/From Platform	9.2%	70%
5	Platform Surface	8.7%	56%
6	Timetable Info & Announcements	8.3%	59%
7	Ease of Ticket Purchase	7.6%	53%
8	Car Parking & Car Pick Up	7.6%	57%
9	Station Lighting	6.6%	57%
10	Ability to buy food, drinks, paper	4.4%	39%
11	Ease of Bus Transfer * Bus Users^	2.8%	58%
12	Availability & Helfulness of Staff	2.2%	55%
13	Toilet Availability & Cleanliness	2.2%	34%
	Overall Station Rating	100%	58%

^ passengers accessing by bus (8% of total)

In terms of relative attribute importance, *cleanliness/graffiti* was the most important station attribute (explaining 17% of the overall rating) followed by *weather protection* and *platform seating* at just over 10% each. Thus the top three factors were exactly the same as for bus stops.

Six attributes were of middling importance: *ease of platform access, platform surface, information, ticket purchase, car parking* and *lighting* with each explaining just under 10%. Of least importance were *retail* 4%, *bus transfer* 3%, *staff* 2% and *toilets* 2%.

In terms of value, improving *cleanliness and graffiti* by 10% points (from 56% to 66%) was predicted to increase the overall rating by 2% points and be worth 1% of the average fare.

By market segment, shoppers attached more importance to *platform seating* and *staff* and less on *cleanliness/graffiti, retail facilities* and *car parking* as the summary in table 9.8 shows. Retired passengers attached more weight to *platform seating* and females gave more importance to *station lighting* than males. Young respondents (<18) attached more importance to the *ease of getting on and off the platform* and *ticketing* and less importance to *cleanliness/graffiti*. Infrequent rail users attached relatively less importance to *bus transfer facilities* than regular train users.

Table 9.8 Station attribute importance with passenger type

Attribute	Market Segment	Effect
Platform Seating	Shopping	+
Cleanliness/Graffiti	" " "	-
Staff	" " "	+
Retail	" " "	-
Car Parking	" " "	-
Platform Seating	Retired	+
Lighting	Female	+
Platform On/Off	Young (<18)	+
Cleanliness/Graffiti	" " "	-
Ticketing	" " "	+
Bus Transfer	Infrequent Users	-

Legend: + More important - Less important

9.11 Bus stop and train station rating comparison

The highest-rated train stations were 'hub' stations (averaging 74%) which had the most facilities. Likewise the highest-rated bus stops were bus stations which also rated at 74%. Some low-rated train stations brought the rail average down below that of bus stops and as a consequence, the willingness to pay was 2% lower for the average major train station and 4% lower for the average local station compared with the average bus stop.

Table 9.9 Rating and relative value of bus stops and train stations

		Stop/Station Rating			% Fare Value		
Mode	Category	Av	High	Low	Av	High	Low
Rail	Hub	74%	79%	71%	5%	7%	3%
Rail	Major	60%	76%	38%	-2%	6%	-14%
Rail	Local	56%	76%	25%	-4%	6%	-22%
Rail	All	58%	79%	25%	-3%	7%	-22%
Bus	Station	74%	80%	64%	5%	8%	0%
Bus	City Centre	67%	73%	63%	2%	4%	-1%
Bus	Suburban	62%	71%	46%	-1%	3%	-10%
Bus	All	64%	80%	46%	0*	8%	-10%

* Base on which other values were estimated

9.12 Fashioning a super model

The large data base enabled the willingness-to-pay valuations to be segmented by a range of passenger and trip characteristics. Table 9.10 summarises the significant effects.

In terms of in-vehicle travel time, males were less sensitive than females (by around a fifth), with house persons, unemployed passengers, older passengers and Auckland bus users less sensitive than other users.

Company business trips were much less sensitive (-44%) to fare and young passengers more sensitive. Older passengers were also less sensitive to fare (probably reflecting the entitlement to free travel with a

SuperGold Card). Auckland bus users were less sensitive and Christchurch bus users more sensitive to fare than Wellington bus users.

Passengers making shopping trips had a lower sensitivity to service interval as did house persons, older passengers and Auckland bus users, whereas passengers travelling in the PM peak were more sensitive.

Rail respondents and also respondents making shopping trips were more sensitive to stop quality.

Passengers visiting friends and relatives or making entertainment/holiday trips were more sensitive to vehicle quality than commuters or passengers making 'other' trips. Likewise, Wellington rail users were also more sensitive to vehicle quality than Auckland train users.

Table 9.10 Trip and mode/city 'super model'

Variable	Parameter	Effect
Gender	Male*IVT	-22%
Journey Purpose (Base = Work)	Comp Business * Fare	-44%
	Shopping * SI	-22%
	Shopping * Stop Quality	39%
	VFR * Vehicle Quality	38%
	Ent/Hol * Vehicle Quality	52%
Socio-Econ Status (Base = Employed)	House Person * SI	-33%
	House Person * IVT	-27%
	Unemployed * IVT	-44%
Age Group (Base = 25-64)	Age <18 * Fare	12%
	Age 18-24 * Fare	9%
	Age>64 * SI	-43%
	Age>64 * IVT	-43%
	Age>64 * Fare	-59%
Time Period	PM Peak * SI	30%
Mode (Base=Bus)	Rail * Stop Quality	44%
City & Mode (Base = WTN Bus)	WTN Rail * SI	-48%
	WTN Rail * Vehicle Quality	56%
	AUC Bus * SI	-30%
	AUC Bus * IVT	-17%
	AUC Bus * Fare	-13%
	CHC Bus * Fare	22%

Model #11 (without IVT and SI interactions)

9.13 Respondent comments

Over 1,100 respondents who completed the rating questionnaire made a comment. Some of the comments provided useful suggestions for the transport sector to consider.

Nine hundred respondents were also willing to participate in a future internet survey (by giving their email address) which provides a panel to monitor attitudinal changes and perhaps look at attributes such as interchange, reliability and crowding that were not covered by the study.

9.14 Concluding remarks and recommendations

By using a rating survey with a SP survey, a flexible and cost-effective methodology was developed that could handle different 'packages' of improvements.

As well as being able to value new buses and trains and also new facilities for bus stops and station upgrading, the approach can value changes in operational factors such as cleanliness/graffiti and staff.

A similar study using the same rating and SP approach was undertaken by Douglas Economics for the Bureau of Transport Statistics NSW and Transport for NSW covering bus, rail, light rail (Douglas Economics 2014) and for Public Transport Victoria covering bus, tram and rail (Douglas Economics and Sweeney Research 2014). It would be useful to compare and contrast the New Zealand, Sydney and Melbourne values thereby widening the range of vehicles and stop/stations covered.

There could be merit in surveying Dunedin, Hamilton and the smaller towns of New Zealand. The survey could also be repeated after major changes have been made (eg after Auckland rail electrification). Ferry users could also be surveyed using questionnaires that would need only minor modification.

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