Best Practice Approaches to Public Transport Amenity/Soft Factor Valuation

Research Literature Review
[Revised Draft]

Prepared for Adrian Webb
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13 December 2017

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Contents

1. Introduction

The Public Transport Research Group at Monash University has been commissioned by Transport for Victoria to undertake a review of best practice approaches to public transport amenity/soft factor valuation. The research aims to:

- Review evidence on measured values with regard to public transport customer experience initiatives
- Understand current practices in the use and adoption of these methods in Australia and internationally in public transport
- Understand what can and cannot be measured in terms of customer experience initiatives
- Explore methods used to measure amenity/soft factor values, their pros and cons and what is considered good practice.

The review includes the following key tasks:

1. Research Literature Review
2. Review of World Transit Industry Practice
3. International Practitioner Delphi Survey.

This is the first report of the research covering Task 1: Research Literature Review. This is a revised draft of the literature review which incorporates input and comments received by Transport for Victoria at a workshop held in November 2017.

2. This Report

2.1 Context

A diverse range of factors can affect the quality of public transport, typically classified as 'hard' or 'soft' factors (Fearnley et al. 2015). Hard factors are physical measures that impact on journey times and reliability, and can also include changes to fares and service provision in terms of frequency, operating hours and spatial coverage (Robson 2009). Hard factors are more easily quantified in terms of their impact on access/egress time, waiting time, in-vehicle time and reliability. In contrast, soft factors, or customer amenities as referred to herein, cover a range of ancillary improvements which are not directly related to operations or service quantity but can enhance the quality of the passenger experience (Currie et al. 2013). Examples of customer amenities include information provision, passenger facilities, station/stop quality, and personal security measures. Customer amenities can also include people (e.g. customer service staff) and are therefore not limited to physical objects alone (Project for Public Spaces & Multisystems Inc. 1999).

Considerable research has been undertaken to understand the value that public transport passengers place on various hard factors, particularly service related attributes (Wardman 2001) and reductions in crowding (Li & Hensher 2011). These valuations are most commonly expressed in monetary units, in in-vehicle travel time equivalents or as a percentage of the fare. There has also been extensive effort to produce syntheses of existing valuations to understand the relative value of various hard factors and to also facilitate the adoption of existing values to other contexts, a method commonly referred to as benefit or value transfer (Australian Transport Council 2006; Booz Allen & Hamilton 2000; Robson 2009; Transport for London 2014; Wardman & Whelan 2001). However, research into public transport customer amenity valuations, or soft factors, is less common with little in the way of any detailed synthesis on the topic.

2.2 Aim and Objectives

This report aims to **synthesise existing research and practice relating to the valuation of public transport customer amenities**. Key research objectives to achieve this aim are:

1. To develop a **typology** of customer amenities for key stages of the public transport journey
2. To understand **methods** used to estimate and apply public transport customer amenity values
3. To synthesise **existing values** to understand their relativities and variability
4. To identify **key issues** associated with the valuation of public transport customer amenities
5. To understand **best practices** in valuing public transport customer amenities
6. To identify **key knowledge gaps** in the field and opportunities for future research.

2.3 Structure

This report is structured as follows. Section 3 outlines the method used in undertaking the literature review. Each research objective is then addressed in subsequent parts. Section 4 provides a typology of customer amenities, while Section 5 presents methods that have been used in estimating and applying values. Section 6 provides a synthesis of existing values, at both an aggregate and disaggregate level. Section 7 highlights key issues associated with valuing customer amenities, with best practices covered in Section 8. Additional issues raised by Transport for Victoria are explored in Section 9, with research gaps identified in Section 10. Concluding remarks and a discussion of the implications for practice are provided in Section 11. A set of appendices are also included: Appendix A provides a list of key contacts in the field, to be used to target practitioners and academics for a survey in subsequent stages of the research, while Appendix B provides a detailed summary of existing amenity values.

3. Research Method

In order to meet the objectives of this study, a literature review of research papers, reports and guidelines relating to public transport customer amenity valuations was undertaken. In addition to a general internet search for relevant publications, the following databases were used: ScienceDirect, Scopus, Transportation Research International Documentation (TRID), and World Transit Research. When searching for relevant literature, variations of the following search terms were used in the context of public transport: *customer amenity*, *soft factor*, *attribute*, *preference*, *valuation*, *monetary value* and *willingness to pay*. The authors also drew heavily upon their knowledge and experience with public transport customer amenity valuations to source additional literature, particularly consulting reports which were not all publicly available. Following an initial scan of publications, additional literature was identified through a snowballing technique by reviewing the list of references in each publication (Van Wee & Banister 2016).

Following a review of the title, abstract/executive summary and references of each publication, a total of 58 publications were deemed to be relevant to the valuation of public transport customer amenities. Table 1 details the types of publications that were used for the literature review, including their year of publication. Across all 58 publications, most were either journal articles (28%) or consulting reports (24%). While most of the literature that was sourced had been published within the last ten years or so (57% since 2006), a relatively consistent base of literature was also sourced from earlier years.

Table 1: Literature sourced by type and year of publication

Publication type	Year of publication					Total
	1995 or earlier	1996 – 2000	2001 – 2005	2006 – 2010	2011 or later	
Journal article	1	2	2	7	4	**16 (28%)**
Conference paper	2	1	1	3	1	**8 (14%)**
Consulting report	-	5	4	3	2	**14 (24%)**
Other report	3	1	-	2	7	**13 (22%)**
Guidelines	1	1	1	3	1	**7 (12%)**
Total	**7 (12%)**	**10 (17%)**	**8 (14%)**	**18 (31%)**	**15 (26%)**	**58 (100%)**

4. A Typology of Public Transport Customer Amenities

Table 2 provides a full list of public transport customer amenities identified by the literature. The amenities are divided into each main stage of the public transport journey: access/egress, waiting, boarding/alighting, and in-vehicle. Some amenities appear more than once given that they can be relevant for multiple stages of the public transport journey, e.g. electronic displays can be used at stations/stops and also inside vehicles. Each amenity has also been classified into one or more of the following six types:

- **Access:** refers to amenities that assist customers in travelling to, from and within station/stops and vehicles; also includes 'accessibility' related aspects for customers with mobility restrictions
- **Facilities:** generally refers to physical objects and services, e.g. ticket machines, retail outlets
- **Information:** amenities such as timetables, maps, help points and directional signage
- **Security:** refers to amenities to support personal safety and security such as surveillance cameras, lighting and staff; can also include amenities that detract from personal safety such as graffiti
- **Environment:** generally covers air quality, temperature control (heating/cooling), ventilation and noise related aspects of the public transport journey
- **Condition:** refers to the physical condition and appearance of amenities such as cleanliness and the presence of graffiti.

Across all stages of the journey, a total of 97 public transport customer amenities were identified in the literature. Most of these relate to the 'waiting' stage of the journey undertaken at stations/stops (46 amenities, or 47% of the total), followed by the 'in-vehicle' stage (33 amenities, 34%). Only 11 types of 'access/egress' amenities and seven types of 'boarding/alighting' amenities were identified in the literature (accounting for 11% and 7% of the total respectively).

In terms of amenity types, the largest number identified in the literature related to 'condition' (28 amenities, or 29% of the total) although this was closely followed by 'facilities' and 'security' based amenities (27 amenities each, or 28%). 'Environment' based amenities accounted for the smallest proportion of all six types of amenities (total of 12 amenities, or 12%).

Within a given stage of the public transport journey, there was generally no dominant type of amenity. Exceptions to this included 'access' based amenities for the 'access/egress' stage (accounting for 7 out of 11 amenities) and the 'boarding/alighting' stage (4 out of 7 amenities), plus 'security' based amenities for the 'in-vehicle' stage (13 out of 33 amenities).

While the sources of literature used for compiling Table 2 were not intended to be exhaustive (the intention was to only provide enough examples to help illustrate the extent of amenity types that have been considered), customer amenities that were most commonly cited included:

- W6: Cleanliness of station/stop
- W10: Electronic displays/real-time information
- W19: Lighting
- W32: Retail/food outlets
- W34: Seating (at station/stop)
- W35: Shelter/platform canopy
- W36: Staff
- W44: Toilets
- IV18: Noise (in-vehicle)
- IV24: Seating (in-vehicle).

Table 2: Typology of public transport customer amenities by journey stage

ID	Amenity	Amenity type						Relevant modes			Sources*
		Access	Facilities	Information	Security	Environment	Condition	Train	Tram	Bus	
ACCESS/EGRESS											
AE1	Bicycle parking outside station/stop	✓	✓					✓	✓	✓	[1-2,19-20,23]
AE2	Building exterior of station/stop						✓	✓	✓	✓	[1,7]
AE3	Car parking		✓					✓	✓	✓	[2,11,13,16-17,19-20,23]
AE4	Directional signage to station/stop			✓				✓	✓	✓	[1]
AE5	Entrance visibility to station/stop	✓						✓	✓	✓	[1]
AE6	Lighting				✓			✓	✓	✓	[1-3,10,13-14]
AE7	Pedestrian crossing	✓						✓	✓	✓	[7]
AE8	Onwards connections outside station/stop	✓						✓	✓	✓	[1,11,17,19,24]
AE9	Step free access to station/stop	✓						✓	✓	✓	[1]
AE10	Taxi rank outside station/stop	✓						✓	✓	✓	[1,23]
AE11	Wide ticket barrier gates	✓						✓			[1]
Sub-total = 11 access/egress based amenities		**7**	**2**	**1**	**1**	**0**	**1**	**11**	**10**	**10**	
WAITING											
W1	Air quality					✓		✓	✓	✓	[1]
W2	Appearance of station/stop						✓	✓	✓	✓	[1,10,15-16,19-20]
W3	Art						✓	✓			[2,25]
W4	ATMs		✓					✓			[1,23]
W5	Cabling						✓	✓	✓	✓	[1]
W6	Cleanliness of station/stop				✓		✓	✓	✓	✓	[1-3,6,8,10-11,13,15,17,19,22,24]
W7	Clocks			✓				✓	✓	✓	[1,10,15,20]
W8	Draughts					✓		✓	✓	✓	[1]
W9	Directional signage			✓				✓	✓	✓	[1-2,10-11,19-20,24-25]
W10	Electronic displays/real-time information			✓				✓	✓	✓	[1-3,6-8,10-11,13-17,20,22-23,25]
W11	Escalators	✓	✓					✓			[1-2,19]
W12	Graffiti				✓		✓	✓	✓	✓	[1-3,10-11,15,17,20]
W13	Ground/floor surfacing						✓	✓	✓	✓	[2,11,15,17]
W14	Help point			✓	✓			✓	✓	✓	[1-3,7,10-11,15-16,24]
W15	Information/emergency button			✓				✓	✓	✓	[1-2,8]
W16	Information on outside of vehicle			✓				✓	✓	✓	[1-2,15,22]
W17	Information on system disruptions			✓				✓	✓	✓	[1-2,16,19,23]
W18	Lifts	✓	✓					✓			[1-2,23,25]
W19	Lighting				✓			✓	✓	✓	[1-3,7-8,10,14-17,20,22,24-25]
W20	Litter				✓		✓	✓	✓	✓	[1,3,10,15,20]
W21	Luggage storage		✓					✓			[2,23]
W22	Map of local surrounding area	✓		✓				✓	✓	✓	[1,15]
W23	Map of public transport routes	✓		✓				✓	✓	✓	[1-3,6,8,14,16,20,22,25]
W24	Map of station area	✓		✓				✓			[1]

ID	Amenity	Amenity type						Relevant modes			Sources*
		Access	Facilities	Information	Security	Environment	Condition	Train	Tram	Bus	
W25	Mirrors				✓			✓			[1,20]
W26	Mobile phone real-time information			✓				✓	✓	✓	[1,3]
W27	PA system			✓	✓			✓	✓	✓	[1-2,7,10-11,14,16,20]
W28	Photo booth		✓					✓			[1,15]
W29	Police				✓			✓			[1-2]
W30	Posters			✓			✓	✓	✓	✓	[1]
W31	Public telephones		✓				✓	✓	✓	✓	[1,6-7,10,15,20,23,25]
W32	Retail/food outlets		✓					✓	✓	✓	[1,7-8,13,15,17,19-20,23-25]
W33	Rubbish bins		✓					✓	✓	✓	[20,25]
W34	Seating		✓				✓	✓	✓	✓	[1-3,5-8,10-11,13-15,17,19,22-25]
W35	Shelter/platform canopy		✓				✓	✓	✓	✓	[1-3,6,8,10-11,14-17,19-20,22,24-25]
W36	Staff**			✓	✓			✓	✓	✓	[1-3,7-8,10-11,13-17,19-20,24]
W37	Step free access	✓						✓	✓	✓	[1-2,17]
W38	Surveillance cameras				✓			✓	✓	✓	[1-3,7-8,10,13,15-16,20]
W39	Temperature control (heating/cooling)					✓		✓	✓	✓	[1,7,13, 19]
W40	Timetables			✓			✓	✓	✓	✓	[1,3,6-8,11,14-15,19-20,22]
W41	Ticket machines		✓				✓	✓	✓	✓	[1-4,10,14-15,23]
W42	Ticketing options		✓					✓	✓	✓	[2-3,11,15-17,23]
W43	Ticket office		✓	✓				✓			[1,10,15,19-20]
W44	Toilets		✓				✓	✓	✓	✓	[1,7-8,10-11,16-17,19-20,23-25]
W45	Waiting room		✓		✓	✓	✓	✓	✓	✓	[1,8,10,15-16,19-20]
W46	Wi-Fi access		✓					✓	✓	✓	[1-2]
Sub-total = 46 waiting based amenities		**6**	**16**	**16**	**11**	**4**	**15**	**46**	**36**	**36**	
BOARDING/ALIGHTING											
BA1	Automatic doors		✓					✓	✓		[1,7]
BA2	Cleanliness of vehicle exterior				✓		✓	✓	✓	✓	[1,3,15]
BA3	Décor of vehicle exterior						✓	✓	✓	✓	[1,6,11,17]
BA4	Graffiti on vehicle exterior				✓		✓	✓	✓	✓	[1]
BA5	Hand rails	✓						✓	✓	✓	[2]
BA6	Step free access to vehicle	✓						✓	✓	✓	[1-6,8,11,14-15,17,22,25]
BA7	Vehicle 'newness'						✓	✓	✓	✓	[1,3,8]
Sub-total = 7 boarding/alighting based amenities		**2**	**1**	**0**	**2**	**0**	**4**	**7**	**7**	**6**	
IN-VEHICLE											
IV1	Access between carriages	✓			✓			✓			[1]
IV2	Ability to see between carriages				✓			✓	✓		[1]
IV3	Cleanliness of vehicle interior				✓		✓	✓	✓	✓	[1-3,5-6,8-9,11,13,15,17,22]
IV4	Customer alarms				✓			✓	✓		[1]
IV5	Driver (attitude, helpfulness)			✓	✓	✓			✓	✓	[1-3,5-6,8,11,15,17,22,25]
IV6	Electronic displays/real-time information			✓				✓	✓	✓	[1-4,9,11,15-17,25]

ID	Amenity	Amenity type						Relevant modes			Sources*
		Access	Facilities	Information	Security	Environment	Condition	Train	Tram	Bus	
IV7	Environmental impact of vehicle					✓		✓	✓	✓	[4,11,17]
IV8	Food service on-board		✓					✓			[9,12,23]
IV9	Gangways	✓	✓					✓			[1,9]
IV10	Graffiti on vehicle interior				✓		✓	✓	✓	✓	[1-2,9,11,13,15,17]
IV11	Graffiti alongside track/route				✓		✓	✓	✓	✓	[1]
IV12	Hand rails	✓						✓	✓	✓	[2,16]
IV13	Lighting				✓			✓	✓	✓	[1,11,17,25]
IV14	Litter				✓		✓	✓	✓	✓	[1,3,15]
IV15	Luggage storage		✓					✓	✓	✓	[2,11,16-17,22-23]
IV16	Map of public transport routes			✓				✓	✓	✓	[2,25]
IV17	Multi-purpose areas within vehicle	✓	✓					✓			[1]
IV18	Noise					✓		✓	✓	✓	[1-3,4,9,11-12,15,17-18,25]
IV19	Odour					✓		✓	✓	✓	[2]
IV20	PA system			✓	✓			✓	✓	✓	[1,3,6,16-17,25]
IV21	Posters			✓			✓	✓	✓	✓	[1]
IV22	Power outlets		✓					✓		✓	[2]
IV23	Ride quality					✓		✓	✓	✓	[1,8-9,15,22,25]
IV24	Seating		✓				✓	✓	✓	✓	[1-3,6,8-9,11,13,15-18,22,23,25]
IV25	Smoothness of driving					✓		✓	✓	✓	[1-3,5,11,15,17]
IV26	Staff (non-driver)			✓	✓			✓	✓		[1,13,15-17]
IV27	Surveillance cameras				✓			✓	✓	✓	[1,3-4,8,13,15,25]
IV28	Temperature control (heating/cooling)					✓		✓	✓	✓	[1-2,4-5,8-9,11,15,17,25]
IV29	Toilets		✓				✓	✓		✓	[2,9,11,19,23]
IV30	Ventilation					✓		✓	✓	✓	[1,3,8-9,15,22,25]
IV31	Wheelchair/buggy space	✓						✓	✓	✓	[1,3]
IV32	Wi-Fi access		✓					✓	✓	✓	[1-2,11,17,21]
IV33	Windows				✓		✓	✓	✓	✓	[1,3,15]
Sub-total = 33 in-vehicle based amenities		**5**	**8**	**6**	**13**	**8**	**8**	**32**	**27**	**26**	
Total = 97 amenities across all journey stages		**20**	**27**	**23**	**27**	**12**	**28**	**96**	**80**	**78**	

Sources:

[1] Transport for London (2014)
[2] Outwater et al. (2014)
[3] Robson (2009)
[4] Evmorfopoulos (2007), cited in [3]
[5] Hensher and Prioni (2002)
[6] Steer Davies Gleave (1996), cited in [3]
[7] Steer Davies Gleave (2004), cited in [3]
[8] Nellthorp and Jopson (2004), cited in [3]
[9] Wardman and Whelan (2001)
[10] Travers Morgan (undated)
[11] Douglas Economics and Sweeney Research (2014)
[12] Balcombe et al. (2004)
[13] Booz Allen Hamilton (2007)
[14] Booz Allen Hamilton (2006)
[15] Australian Transport Council (2006)
[16] Steer Davies Gleave (2000)
[17] Douglas and Jones (2016)
[18] Phanikumar and Maitra (2006)
[19] Copley et al. (1998)
[20] Bartley (1991)
[21] Zhang et al. (2006)
[22] Swanson et al. (1997)
[23] Molin and Timmermans (2006)
[24] Yoh et al. (2011)
[25] Project for Public Spaces and Multisystems Inc. (1999)

* The sources listed are not intended to be exhaustive; rather, they seek to provide enough examples to illustrate the range of customer amenities identified in the literature.
** 'Staff' can cover a range of different attributes, e.g. staff visibility, knowledge, willingness to help, appearance.

As a further observation from Table 2, it is noted that some customer amenities, albeit few, may become less relevant to public transport passengers in the future and in some cases may have already ceased to exist. Examples include photo booths (W28), public telephones (W31), and (printed) timetables (W40). There are also other types of customer amenities that are provided as part of basic minimum standards and therefore may have become an expectation among passengers. Examples include lighting at stations/stops (W19) and automatic vehicle doors when boarding/alighting (BA1).

Finally, it is noted that most of the amenities are relevant to all modes of public transport. Of the 97 amenities identified, 96 (or 99%) are considered to be relevant to trains, the one exception being driver attitude and helpfulness (IV5), which is unlikely to apply given train drivers do not normally have any significant interaction with passengers. A total of 80 amenities are considered to be relevant to trams (82% of the total), with 78 amenities relevant to buses (80%).

5. Methods Used to Estimate and Apply Public Transport Customer Amenity Values

A range of methods have been used to estimate and apply public transport customer amenity values. These include the following six types:

1. Stated preference
2. Revealed preference
3. Customer ratings
4. Priority evaluator
5. Maximum difference scaling
6. Benefit/value transfer.

Table 3 provides a brief summary of each method, including an overview of their key advantages and disadvantages. With the exception of the 'benefit/value transfer' method, all of the approaches have been used for *estimating*, rather than *applying*, public transport customer amenity values.

Stated preference can take the form of contingent valuation or choice experiments. Contingent valuation directly asks respondents what they are willing to pay for a hypothetical change in amenity provision. Choice experiments, on the other hand, present respondents with a set of hypothetical alternatives, each containing different levels of attributes/amenities. For each choice experiment, respondents are asked to choose a preferred alternative. When one of the attributes is price, the trade-offs can be used to indirectly measure the willingness to pay for specific amenities (DEFRA 2007; Infrastructure Victoria 2016). While stated preference allows for a set of hypothetical alternatives to be tested, it is typically resource intensive and based on what respondents say they *would do* rather than directly observing their behaviour. In addition, stated preference can be subject to various forms of response bias. These are discussed further in Section 7.

Unlike stated preference, **revealed preference** is based on actual observations of consumer behaviour so there is no measurement error associated with choices that are made (Fearnley et al. 2015). However, it is difficult to use revealed preference for estimating the value of customer amenities given the need to isolate the effects of specific amenities, something not easily observed in practice due to the presence of external factors (Hensher & Prioni 2002; Wardman & Whelan 2001). In addition, revealed preference generally requires large samples and cannot accommodate hypothetical attributes and variability within such attributes (Phanikumar & Maitra 2007).

Both stated preference and revealed preference data is typically analysed using Multinominal Logit (MNL) models due to their simplicity in estimation (Phanikumar & Maitra 2006). However, MNL models impose restrictions such as the Independence of Irrelevant Alternatives (IIA) assumption which states that the odds of choosing A over B should not depend on whether some other alternative C is present or absent. Modifications to MNL models to reduce the influence of restrictions has led to the use of Random Parameter Logit (RPL) or Mixed Logit (ML) models for analysing stated and revealed preference data (Phanikumar & Maitra 2006; Robson 2009).

Table 3: Summary of methods used for estimating and applying public transport customer amenity values

Method	Advantages	Disadvantages
Stated preference Contingent valuation or choice experiments	• Facilitates inclusion of hypothetical attributes and variability of attributes • Can be used to estimate willingness to pay both directly and indirectly	• Resource intensive • Can suffer from bias in responses • Asks what respondents *would do* rather than directly observing their behaviour
Revealed preference Direct observation of consumer behaviour	• Based on observed behaviour rather than stated intentions • Overcomes bias in responses associated with stated preference	• Difficult to isolate effects of individual amenities due to external factors • Cannot accommodate hypothetical attributes and associated variability • Large survey sample generally required
Customer ratings Measurement of importance and/or performance of amenities	• Appropriate given that many amenities do not have any natural units • Relatively simple and easy to use • Cost effective	• Cannot estimate monetary or time value of amenities when method is used in isolation of other techniques
Priority evaluator Allocation of hypothetical budget across a set of amenity improvements	• Facilitates inclusion of hypothetical attributes and variability of attributes • Relatively simple and easy for respondents to understand	• Identifies stated rather than revealed preferences • May become difficult for respondents where number a large number of amenity improvements is included
Maximum difference scaling Seeks best and worst amenity features	• Facilitates inclusion of hypothetical attributes and variability of attributes	• Resource intensive • Identifies stated rather than revealed preferences
Benefit/value transfer Adoption of values from previous studies/locations	• Cost effective as primary valuation studies are not required • Transparent and easy to apply	• Relies heavily on the availability and validity of existing studies • Values may not be appropriate for the selected context

Source: Authors' synthesis of the literature (Bristow et al. 1991; British Railways Board 1994; Copley et al. 1998; Cuthbertson et al. 1993; DEFRA 2007; Douglas Economics & Sweeney Research 2014; Douglas & Karpouzis 2006; eftec 2009; Fearnley et al. 2015; Infrastructure Victoria 2016; Mott MacDonald 2013; OECD & ITF 2014; Outwater et al. 2014; Phanikumar & Maitra 2007; Swanson et al. 1997; Wardman & Whelan 2001).

Customer ratings can be used to estimate the relative level of importance that customers place on different amenities, but may also be used to seek the level of satisfaction/performance associated with such amenities, commonly referred to as importance-performance analysis (Bartley 1991; Copley et al. 1998; Cuthbertson et al. 1993; Project for Public Spaces & Multisystems Inc. 1999). A customer rating survey typically asks respondents to rate a series of amenities on a scale, e.g. 0 (very poor) to 9 (excellent), 0-100% (Dahlgren & Morris 2004). Rating based approaches have considerable attraction for the valuation of customer amenities given that most amenities have no natural units or otherwise have natural units (e.g. decibels) which cannot be easily interpreted by customers (OECD & ITF 2014). However, a key disadvantage of the technique is that monetary or time equivalent values for different amenities cannot be obtained without combining the results with that obtained from other methods, e.g. stated preference (Douglas 2015).

The **priority evaluator** method involves inviting respondents to allocate a hypothetical budget over a range of possible amenities, or improvements to existing amenities, in such a way that their utility is maximised (Copley et al. 1998; Pearmain 1992). Amenity values can then be derived according to the preferences given by respondents in allocating their budget. Given that the priority evaluator method helps to elicit preferences and identify trade-offs among respondents, it could be placed under the umbrella of stated preference techniques. However, the method is considered separately here to help demonstrate the range of techniques used for valuing public transport customer amenities.

Maximum difference scaling, also known as best-worst scaling, involves respondents choosing their most and least preferred options from a set of alternatives. It is useful for obtaining rankings and relative preferences for a range of different amenities (Outwater et al. 2014). Questions are repeated a number of times with the list of attributes varied so that the best and worst features can be selected by

respondents. As with the priority evaluator method, maximum difference scaling could be viewed as a form of stated preference but is considered separately here.

Unlike the above methods which have been used to *estimate* public transport customer amenity values, **benefit (or value) transfer** involves the *application* of readily available valuation evidence to a new context where a valuation may be required (eftec 2009). Values are simply 'transferred' (and adjusted in some cases) from other jurisdictions or studies to the particular context of interest. While this represents a much quicker and lower cost approach to valuation (DEFRA 2007), the method relies heavily on the availability and validity of existing studies. Furthermore, differences in location, study design and other contextual factors may result in data comparability issues (Brouwer 2000). Where suitable valuation evidence is available from an international study, values are typically converted to the desired currency and year using Purchasing Power Parity (PPP) adjusted exchange rates. These control for distortions in economic values that the application of ordinary exchange rates may introduce (Barrio & Loureiro 2010; de Groot et al. 2012).

Table 4 provides an overview of methods used in previous studies for estimating the value of public transport customer amenities. These studies were undertaken across a range of countries including Australia, India, Netherlands, New Zealand, Norway, United Kingdom and the United States. Data collection across the studies was undertaken between the years of 1991 to 2013.

As shown by Table 4, the use of stated preference was the dominant method used to estimate the value of public transport customer amenities, used in 22 out of the 28 studies (79%). This was followed by customer ratings (used in 14 studies), priority evaluator (5 studies), revealed preference (3 studies) and maximum difference scaling (1 study). In some cases, multiple methods were used to value public transport customer amenities. For example, Douglas Economics and Sweeney Research (2014) used a combined stated preference and customer rating approach. Here, a stated preference survey was undertaken to develop willingness to pay values for *overall* vehicle and station/stop quality. The relative importance of different amenities, as rated by customers, were then applied to the willingness to pay values to derive values for individual amenities.

Despite the advantages of using revealed preference where consumer behaviour is directly observed, examples in the context of public transport customer amenity valuations are particularly limited (Robson 2009). Wardman and Whelan (2001) note that even when evaluating rolling stock amenities, it is unlikely that revealed preference data would support the analysis of all relevant rolling stock types, and that even large sample sizes would not guarantee precise estimates.

Other observations to note from Table 4 relate to the survey sample size and public transport modes assessed. Survey samples were considerable in most studies, often exceeding 1,000 respondents. Only one study (Molin & Timmermans 2006) had a sample size of less than 400 respondents. Valuations were predominantly undertaken of train (18 studies) and bus (14 studies) related amenities. Only six studies valued tram related amenities, which presumably reflects the absence of this public transport mode in some cities compared with train and bus. Only four studies valued customer amenities across train, tram and bus services collectively (Douglas Economics & Sweeney Research 2014; Douglas & Jones 2016; Outwater et al. 2014; Yoh et al. 2011).

Table 4: Methods used in previous studies for estimating the value of public transport customer amenities (ordered by year of publication)

Source	Location	Survey year	Sample size	Survey method					Mode		
				Stated preference*	Revealed preference	Customer ratings**	Priority evaluator	Maximum difference scaling	Train	Tram	Bus
Bartley (1991)	Australia	1991	626			✓			✓		
Pearmain (1992)	United Kingdom	1990-91	1,122	✓					✓		
Cuthbertson et al. (1993)	United Kingdom	Not stated	1,810	✓		✓			✓		
Steer Davies Gleave (1996)	United Kingdom	1995	947	✓							✓
Copley et al. (1998)	Netherlands	1986	Not stated	✓		✓	✓		✓		
Project for Public Spaces and Multisystems Inc. (1999)	United States	Not stated	568			✓	✓				✓
Steer Davies Gleave (2000)	United Kingdom	2000	1,484	✓					✓		
Wardman and Whelan (2001)	United Kingdom	1997	3,131	✓	✓	✓			✓		
Accent (2002)	United Kingdom	2001	2,373	✓		✓					✓
Hensher and Prioni (2002)	Australia	1999	3,849	✓							✓
Dahlgren and Morris (2004)	United States	2002	958			✓					✓
Douglas Economics (2005)	New Zealand	2002/2004-05	4,683			✓	✓		✓		
Halcrow (2005)	Australia	2005	926	✓			✓		✓		
Booz Allen Hamilton (2006)	Australia	2006	457	✓			✓			✓	
Douglas and Karpouzis (2006)	Australia	2004-05	3,828			✓			✓		
Molin and Timmermans (2006)	Netherlands	Not stated	184	✓		✓			✓		
Phanikumar and Maitra (2006)	India	2004	1,021	✓							✓
Zhang et al. (2006)	Netherlands	2004	836	✓					✓		
Booz Allen Hamilton (2007)	Australia	2007	2,031	✓					✓		
Phanikumar and Maitra (2007)	India	Not stated	475	✓							✓
Preston et al. (2008)	United Kingdom	2007	4,174	✓	✓				✓		
Robson (2009)	United Kingdom	2008	4,750	✓	✓						✓
Fearnley et al. (2011)	Norway	2009	408	✓						✓	✓
Yoh et al. (2011)	United States	2006-09	2,247			✓			✓	✓	✓
Outwater et al. (2014)	United States	2009/2011	5,059	✓				✓	✓	✓	✓
Douglas Economics and Sweeney Research (2014)	Australia	2014	1,884	✓		✓			✓	✓	✓
Douglas (2015)	New Zealand	2012-13	12,557	✓		✓			✓		✓
Douglas and Jones (2016)	Australia	2013	6,710	✓		✓			✓	✓	✓
Total of 28 studies				**22**	**3**	**14**	**5**	**1**	**18**	**6**	**14**

Source: Authors' synthesis of the literature based on the citations included in the table.

* Includes use of contingent valuation and choice experiments to estimate willingness to pay for different amenities.

** Typically seeks the level of importance placed on different amenities, but in some cases includes ratings of both importance and satisfaction/performance (Bartley 1991; Copley et al. 1998; Cuthbertson et al. 1993; Project for Public Spaces & Multisystems Inc. 1999).

6. Synthesis of Public Transport Customer Amenity Values

6.1 The Amenity Valuation Dataset

This section presents a synthesis of existing public transport customer amenity values assembled from the literature reviewed. In total, data for 556 cleaned/validated separate valuations were assembled from 6 countries with valuation dates between 1992 and 2013.

While a considerable number of studies have valued public transport customer amenities, only those which reported values in monetary units or in-vehicle time were considered. Studies that valued amenities in qualitative terms or rated customer amenities on a scale (e.g. 0-10) could not be included as their values could not be converted with much accuracy. In addition, values reported by intercity rail passengers, as documented by Preston et al. (2008) and Steer Davies Gleave (2000), were excluded from the synthesis which focuses on urban public transport values. Furthermore, some exceptionally high valuations were reported in these studies (e.g. up to 60 minutes of equivalent in-vehicle time for some amenities), which would otherwise have the effect of distorting the presentation of other values reported in the literature.

6.2 Approach to Valuation

All values were converted to equivalent units of in-vehicle time (minutes) where not already reported in these units. To convert international monetary values to in-vehicle time, the values were first converted to Australian dollars using Purchasing Power Parities (PPPs) published by OECD (2016) to better control for distortions in economic values that the application of ordinary exchange rates may introduce (eftec 2009). Values of time for public transport users (AU$8.80/hr for bus users and AU$10.25/hr for train and tram users) published by the Australian Transport Council (2006) were then used to convert the dollar values to equivalent in-vehicle time (minutes).

6.3 Results

Appendix B provides detailed evidence of existing public transport customer amenity values reported by the literature, using the same typology of customer amenities developed in Section 4. The discussion below presents an overview of the values at both aggregate and disaggregate levels.

6.4 Aggregate Amenity Type Valuations

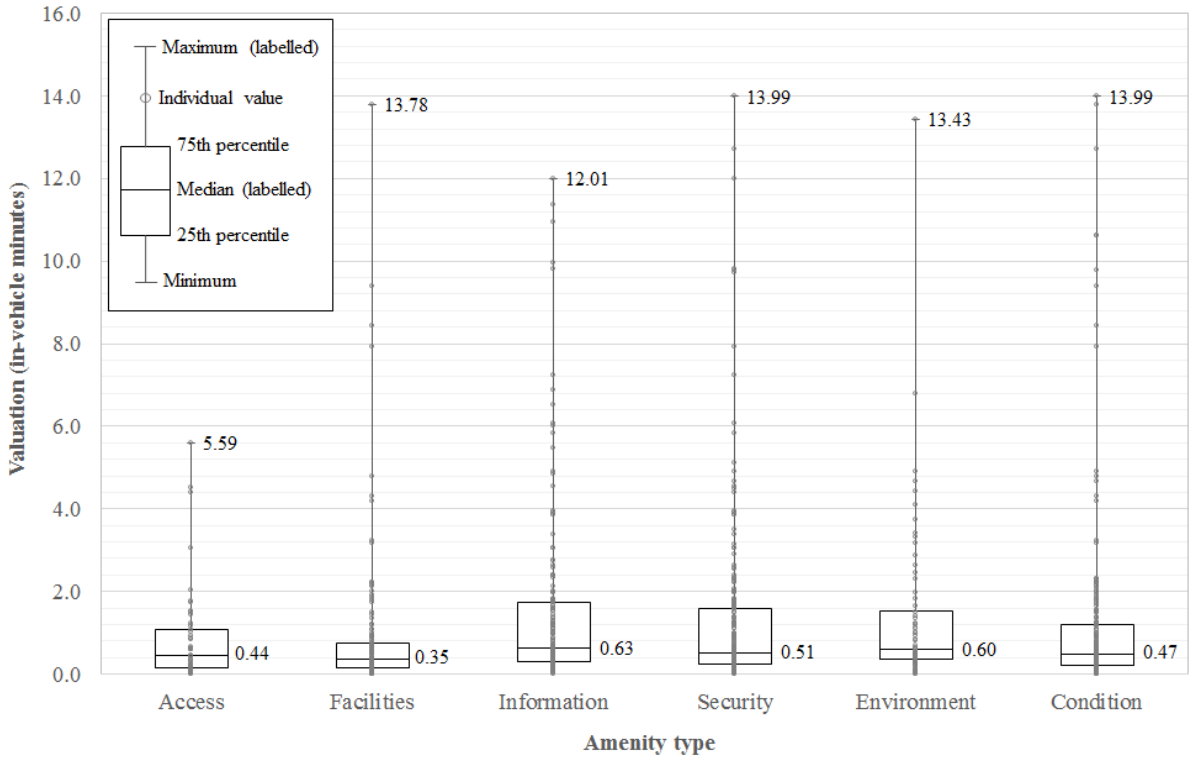
A summary of average amenity values by Amenity Type (Access, Facilities, Information, Security, Environment and Condition) is presented in Figure 1. These type categories cover a wide range of individual amenity aspects but serve to explore the aspects of amenities of concern to passengers.

Figure 1 shows considerable variability in customer amenity values. While the 75th percentile values are all under 2 minutes, individual values of up to 14 minutes were found. Given this would cause the calculation of ‘average’ values to be skewed towards these maximum values, the reporting of median values is clearly more appropriate.

Figure 1 shows little difference in median values by amenity type, perhaps with the exception of facility based amenities which are shown to have a lower median value than other amenities and also a narrower range of values within the 25th to 75th percentile. Of the amenity type categories explored, Environment (0.60), Information (0.63) and Security (0.51) have the highest median values.

Another key observation is that median valuations are in general all below a single minute in value and even the 75th percentile of the range of values is below 2 minutes. The implication is that while amenities are of clear value to customers, their value is in generally small compared to overall travel time (typically over 30-60 minutes).

Figure 1: Variability of existing public transport customer amenity values by amenity type



Source: Authors' analysis of existing public transport customer amenity values (Accent 2002; Australian Transport Council 2006; Balcombe et al. 2004; Booz Allen Hamilton 2006, 2007; Currie et al. 2013; Douglas Economics 2006; Douglas 2016b; Douglas & Jones 2016; Fearnley et al. 2011; Hensher & Prioni 2002; London Transport 1997; Phanikumar & Maitra 2006; Robson 2009; Steer Davies Gleave 1996, 2000; Transport for London 2014; Travers Morgan undated; Wardman & Whelan 2001). Note: excludes valuations made by intercity rail passengers (Preston et al. 2008; Steer Davies Gleave 2000). Purchasing power parities (OECD 2016) and public transport user values of time (Australian Transport Council 2006) were used to convert values to equivalent units of in-vehicle time (minutes) where needed.

6.5 Disaggregate Amenity Type Valuations by Mode

Table 5 provides a more detailed summary of public transport customer amenity values through reporting median values (and their associated minimum and maximum ranges) by amenity type, journey stage and public transport mode. The distribution of Rail vs. Bus results are also illustrated in Figure 2.

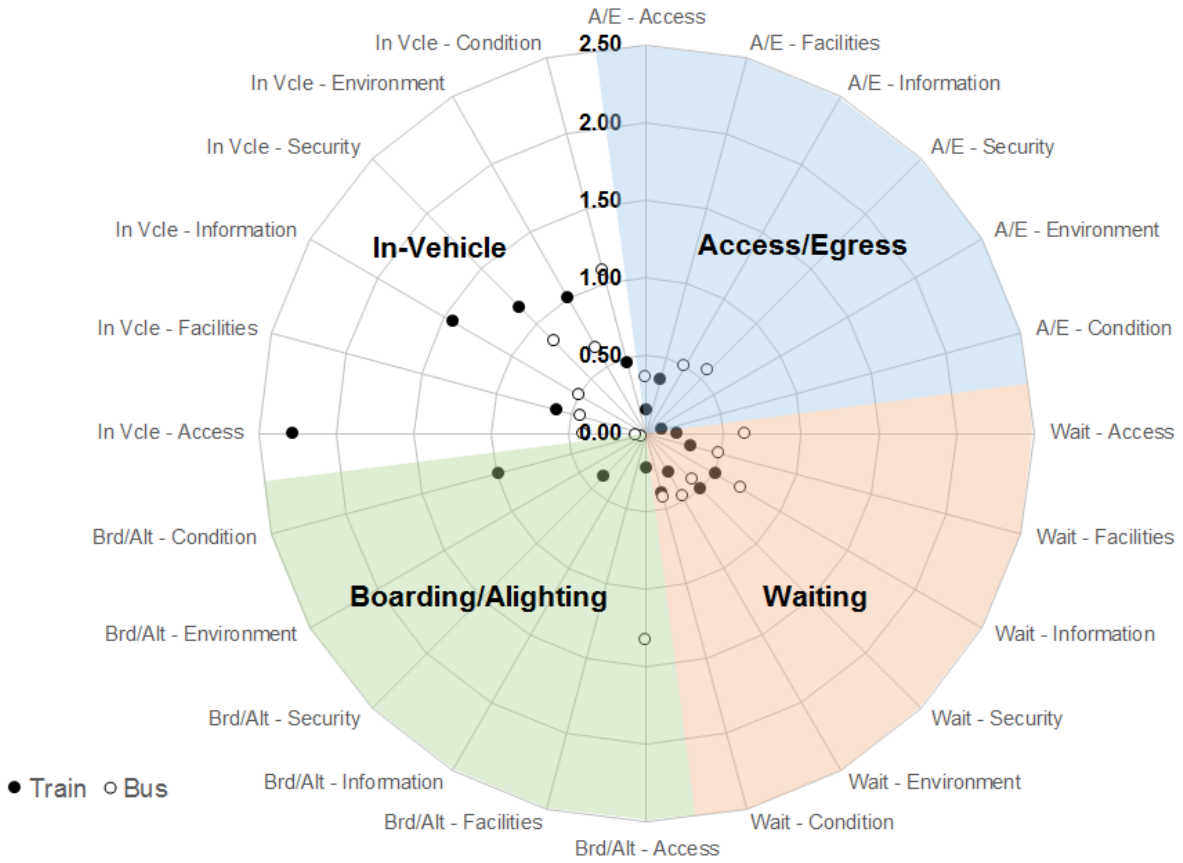
There is a lack of values available for tram-based amenities, compared with those for train and bus. This is consistent with the finding earlier from Table 4 which highlighted the relatively small number of tram-based amenity studies that have been undertaken to date. There are also gaps in the valuation of some train and bus amenities for the access/egress stage of the journey. These include 'information' and 'security' related amenities for train, and 'facilities' and 'condition' related amenities for bus.

However, overall there is an interesting pattern between the bus and rail values: bus values for out of vehicle activities (access/egress, waiting and boarding/alighting) are in general higher than those for rail. However, within vehicle, rail values are considerably higher than bus. This might be representative of the relative importance of in-vehicle time in rail which is larger due to longer travel distances. Out of vehicle time is a higher share of total journey time for bus, hence valuations of amenities for these values are greater.

Table 5: Summary of existing public transport customer amenity values by journey stage and amenity type

Amenity type	Median value (range in brackets): in-vehicle minutes		
	Train	Tram	Bus
ACCESS/EGRESS			
Access	0.15 (0.01 - 0.93)	-	0.36 (0.10 - 1.02)
Facilities	0.36 (0.01 - 1.80)	-	-
Information	-	-	0.50 (0.37 - 0.98)
Security	-	-	0.57
Condition	0.10	-	-
WAITING			
Access	0.20 (0.03 - 0.22)	-	0.64 (0.10 - 1.74)
Facilities	0.30 (0.00 - 9.40)	0.50 (0.32 - 0.55)	0.49 (0.10 - 13.78)
Information	0.52 (0.03 - 12.01)	0.30 (0.09 - 0.65)	0.70 (0.10 - 10.95)
Security	0.50 (0.02 - 13.99)	0.22 (0.09 - 1.21)	0.43 (0.10 - 2.91)
Environment	0.29 (0.03 - 1.35)	-	0.47 (0.34 - 1.98)
Condition	0.40 (0.00 - 13.99)	0.48 (0.32 - 0.55)	0.43 (0.03 - 13.78)
BOARDING/ALIGHTING			
Access	0.22 (0.08 – 1.50)	0.24	1.33 (0.05 - 5.59)
Security	0.38	-	0.03 (0.02 - 0.10)
Condition	0.98 (0.15 - 10.61)	-	0.07 (0.02 - 1.57)
IN-VEHICLE			
Access	2.28 (0.47 - 4.39)	-	0.40 (0.19 - 0.61)
Facilities	0.60 (0.05 - 1.75)	-	0.44 (0.02 - 2.21)
Information	1.44 (0.16 - 6.88)	-	0.50 (0.02 - 11.35)
Security	1.15 (0.08 - 9.72)	-	0.84 (0.02 - 9.81)
Environment	1.01 (0.10 - 6.79)	0.45 (0.22 - 0.50)	0.64 (0.00 - 13.43)
Condition	0.47 (0.05 - 1.75)	-	1.08 (0.02 - 9.78)

Figure 2: Median amenity values by journey stage, amenity type and rail, bus mode



6.6 Disaggregate Amenity Values

Appendix B details median and range values for each of the 97 individual customer amenity types. Key features are briefly outlined below.

Access/Egress – highest median valuations (in-vehicle minutes) are for bus step free access (1.02), rail step free access (0.64), bus directional signage (0.68), bus stop lighting (0.57) and bus stop entrance visibility (0.50). All other median valuations are below 0.40 minutes.

Waiting – rail real time displays had the highest median valuations in this group (2.75), valued much higher than tram (0.48) and bus (0.99). A high stop cleanliness value was found for tram (1.21), much higher than rail/bus (0.50/0.39). Information on system disruptions was also valued highly (1.12 for bus and 1.0 for rail). Rail timetable availability (value of 1.52), rail police availability (1.09), ground/floor surfacing (1.07) and surveillance cameras (1.02) were the other high values above one minute in the waiting group of amenities. Bus data identified information on disruptions as highest (1.12), followed by real time displays, PA systems and surveillance cameras (all valued at 0.99 in-vehicle minutes). Tram data valued stop cleanliness highest (1.21), followed by stop shelter/canopies (0.52) and stop ticketing options (0.51).

Boarding/Alighting – rail vehicle newness was the highest median valuation of the data assembled (3.34). This was also the highest boarding/alighting value for bus (bus newness: value of 1.57). Bus step free access (value of 1.33) and exterior décor/cleanliness of rail rolling stock were the next highest values estimated (0.38) in this group.

In Vehicle – the highest median in-vehicle attribute value estimated was 13.43 minutes for the environmental impact of a bus (rail was only 0.59). Interestingly this was the highest of all the median valuations in the whole dataset but is a clear outlier and based on only a single data point of evidence. The next highest value was 3.72 for access between rail carriages. The next highest median in vehicle amenity valuations were rail interior graffiti (3.30, compared to only 0.2 for bus) and bus noise (3.24; rail was only 0.32). Other high in-vehicle values were rail surveillance cameras (2.00), rail ventilation (1.84), rail non-driver staff (1.60) and bus PA system (1.22).

7. Issues Associated with the Valuation of Public Transport Customer Amenities

This section provides an overview of the issues associated with the valuation of public transport customer amenities, as identified by the literature. The issues are listed in Table 6 and have been classified into ‘strategic’ (big picture) and ‘tactical’ (detailed) issues. A discussion of these issues is provided in the sub-sections that follow.

Table 6: Issues associated with the valuation of public transport customer amenities

Strategic issues	Tactical issues
• Variability in values • Application of ‘average’ values for benefit/value transfer • Absence of natural and/or meaningful units • Packaging effect • Interaction and ‘halo’ effects • Changes in customer expectations • Relevance of amenities over time	• Valuations expressed in different units • Definition of amenities and associated quality • Survey response bias • Respondents’ understanding of amenities and associated levels of provision

Source: Authors’ synthesis of the literature (Booz Allen & Hamilton 2000; Bristow et al. 1991; de Groot et al. 2012; Douglas 2015; Dziekan & Kottenhoff 2007; Fearnley et al. 2015; Fearnley et al. 2011; Outwater et al. 2014; Phanikumar & Maitra 2007; Preston et al. 2008; Project for Public Spaces & Multisystems Inc. 1999; Robson 2009; Wardman & Whelan 2001).

7.1 Strategic issues

Arguably the greatest issue associated with the valuation of public transport customer amenities relates to **variability in values**. High levels of variability can make it difficult to estimate values that are directly transferrable from one service or city to another (Booz Allen & Hamilton 2000). Differences in values may be observed through socioeconomic variables such as age, gender and income, but may also differ by location and trip characteristics such as trip purpose, frequency, length and time of day (Fearnley et al. 2015; Phanikumar & Maitra 2007; Robson 2009). Furthermore, the value placed on security based amenities is likely to be higher in areas with higher levels of crime (Booz Allen & Hamilton 2000; Litman 2007) but may also be affected by cultural factors related to fear of crime (Preston et al. 2008). Other socio-psychological factors such as attitudes, lifestyles and aspirations may also affect the variability of public transport customer amenity values. In addition, as found in a study undertaken by Yoh et al. (2011), the value placed on certain amenities such as food outlets can increase with increased waiting times for public transport services.

Given the variability in public transport customer amenity values, the **application of 'average' values for benefit/value transfer** has been a commonly adopted approach in the field. However, as noted by London Transport (1997), where proposals are targeted at particular groups of passengers (e.g. mobility impaired), the application of 'average' values is unlikely to be appropriate. Furthermore, de Groot et al. (2012) notes that the nuances of original studies becomes blurred when individual values are averaged. They recommend that averaged values should only be seen as illustrative, with primary valuation research undertaken when specific policy questions arise.

The **absence of natural and/or meaningful units** for public transport customer amenities is another key issue associated with their valuation. As stated by Wardman and Whelan (2001, p. 431) in the context of valuing noise: "…noise levels have invariably been presented on a categorical scale such as very noisy, noisy, quiet and very quiet and, while this might be meaningful to travellers, the results are not easily interpreted and applied. The estimated values are much more usable when they relate to a metric scale, such as a decibel scale in the case of noise, but this would not be meaningful to respondents". Wardman and Whelan (2001) also note the lack of any natural units of measurement for other amenities such as ride quality and décor which can limit the transferability of their valuations.

The **packaging effect** refers to when values derived for individual amenities sum to an amount that is greater than the value that a respondent would ascribe to the package of improvements as a whole (Robson 2009; Swanson et al. 1997). The reasons for the packaging effect are related to diminishing marginal utility, budget restrictions and the presence of substitution effects, e.g. mobile phone based information may substitute for the use of traditional forms of information (Fearnley et al. 2011). OECD and ITF (2014) note that the packaging effect may also occur because of the artificial nature of stated preference experiments which can attract 'strategic' responses. While the common approach to overcoming the packaging effect is to scale down all valuations so when taken in total they sum to the maximum willingness to pay (Booz Allen & Hamilton 2000; Steer Davies Gleave 2000), the use of stated preference surveys in combination with customer ratings and have also been used to avoid the need to apply any downward adjustments to amenity values (Douglas 2015).

Another strategic issue associated with the valuation of customer amenities relates to the presence of **interaction and 'halo' effects**. Valuations typically assume that improvements to one type of amenity do not have any effect on the value of other amenities. However, this does not always occur in practice. For example, lighting can have a 'halo' effect on how passenger see other amenities such as timetables or the ability to safely board and alight. Improvements to lighting alone may therefore enhance the perceived value of other amenities. Douglas (2015) notes that the estimation of indirect 'halo' effects for Sydney train services approximately doubled the direct effect of improvements to individual amenities. Furthermore, the presence of 'security' staff may enhance the provision of information and other physical assistance that can be provided (Balcombe et al. 2004). Conversely, interaction effects may act to reduce the value of some amenities. For example, the availability of mobile phone based information may reduce the value of staff and information displays (OECD & ITF 2014).

Over time, **changes in customer expectations** may have an effect on the values ascribed to customer amenities as minimum standards increase (Outwater et al. 2014). As noted by Dziekan and Kottenhoff (2007), customers may not be willing to pay for real-time information as they have come to *expect* that the public transport operator will provide this information free of charge. It may be that the quality of customer amenities needs to continually evolve and improve in order to stand still (Robson 2009). Some amenities that may be present in a station environment for instance may even go unnoticed by passengers, unless they are absent or provide an inadequate service (British Railways Board 1994).

A final strategic issue relates to the **relevance of amenities over time**. Features such as public telephones, photo booths and (printed) timetable information are already becoming less relevant to customers with advances in mobile phone technology. In such cases, the value placed on such amenities may decline to a point where they offer little or no perceived value at all. Valuations of customer amenities therefore need to be regularly updated to ensure their relevance is maintained.

7.2 Tactical issues

In addition to the 'strategic' issues identified above, a number of 'tactical' (detailed related) issues can affect the valuation of public transport customer amenities. First, **valuations expressed in different units** can make it difficult to compare values across studies and may also limit the ability to conduct any formal meta-analysis to help determine key factors affecting valuations (Li & Hensher 2011). Examples of different units used in valuation studies include in-vehicle time, currency (e.g. dollars), percentage of the fare, numerical ratings (e.g. out of 100) and reductions in waiting time (Outwater et al. 2014). Monetary units have also been used in the context of valuing set percentage improvements in amenity quality (Douglas & Karpouzis 2006; Transport for London 2014).

Another tactical issue relates to the **definition of amenities and their associated quality**. Again, this can affect the ability to compare values across studies where no consistent definitions are used (Fearnley et al. 2015). However, even when the same wording is used, differences in the presentation of amenities can affect a respondent's valuation. As noted by Outwater et al. (2014), a picture of a crowded bus may have more emotional resonance than text alone referring to a 'crowded bus'. Furthermore, differences in the specification of 'quality' for given amenities may also confound any specific comparisons across studies (Outwater et al. 2014). The example given earlier of different noise levels (very noisy, noisy, quiet and very quiet) is a case in point.

Survey response bias is a common tactical issue associated with the use of stated preference to value customer amenities (Bristow et al. 1991; Preston et al. 2008), typically leading to the estimation of inflated values. The two main types of bias include 'strategic response' bias, where survey respondents may have an incentive to overstate their valuations to influence policy (Robson 2009), and 'non-commitment' bias, where respondents may indicate their preference for certain amenities and lose nothing by doing so but in practice may not use those amenities at all (British Railways Board 1994). However, careful attention to survey design, including the use of revealed preference where possible, can help to overcome such biases (Bristow et al. 1991; Preston et al. 2008; Wardman & Whelan 2001).

Finally, and again related to survey design, **respondents' understanding of amenities and associated levels of provision** may affect the magnitude of values that are estimated. As noted by Robson (2009), both amenities and their levels of provision should be clear and understandable to respondents to ensure that results are useful and are anchored to measurable levels of amenity provision. The issue of unfamiliarity with amenities is also raised by Wardman and Whelan (2001) who note the importance of tailoring choice experiments to include attributes that respondents are familiar with. The use of focus groups and other qualitative approaches can also precede the use of stated preference to ensure amenities are relevant and phrased appropriately to respondents (Cuthbertson et al. 1993; Preston et al. 2008). Best practices such as these, along with others, are discussed in the next section.

8. Best Practices in Valuing Public Transport Customer Amenities

The literature is relatively silent in terms of explicitly stating what is considered best practice in the valuation of public transport customer amenities. However, a number of key elements were identified that were considered to support best practice, as summarised in Table 7. While much guidance is available on best practice in survey design, including general principles for stated preference surveys (e.g. random ordering of questions, fractional factorial designs), this section focuses only on best practices that were identified in the context of public transport customer amenity valuations.

Table 7: Best practices in valuing public transport customer amenities

Best practice element	Description
Customer segmentation	Key customer markets should be segmented in surveys to account for differences in their preferences. Non-users should also be included in surveys.
Respondent familiarity with amenities	Choice experiments should be tailored reflect amenities that customers are familiar with. Images should also be used to aid understanding of amenities.
Controlling of interaction effects	Where possible, interactions between amenities should be controlled for in revealed preference surveys by using a sufficiently heterogeneous sample.
Adoption of rating scales	Rating scales should be used to measure customer preferences for different amenities given the lack of natural measurement units.
Careful application of benefit transfer	Selection of values should consider the validity and reliability of underlying studies. Values should be adjusted as necessary to better reflect the local context.

Source: Authors' synthesis of the literature (Booz Allen Hamilton 2006; Brouwer 2000; Copley et al. 1998; Douglas 2015; Mott MacDonald 2013; Robson 2009; Swanson et al. 1997; Transport for London 2014; Wardman & Whelan 2001, 2011).

Given the wide variation in preferences for amenities between different groups, **customer segmentation** of survey respondents should be undertaken where possible (Booz Allen Hamilton 2006; Mott MacDonald 2013). Non-user preferences should also be accounted for given that they tend to give higher valuations than users (Robson 2009). In addition, if 'average' or 'median' values are applied, sensitivity tests should be undertaken to reflect the preferences of different customer segments (Transport for London 2014).

Stated preference experiments should be tailored appropriately to **aid respondent familiarity with amenities** that are presented (Wardman & Whelan 2001). Amenities included in stated preference surveys should match as closely as possible to what respondents would see in reality. Written and visual presentations of amenities and their associated levels of quality should ideally be tested in focus groups or other qualitative research beforehand to ensure they can be easily understood by respondents (Cuthbertson et al. 1993; Preston et al. 2008; Wardman & Whelan 2011). The use of pictures/images to support respondents' understanding and familiarity of amenities is highlighted by the literature (Li & Hensher 2011; Steer Davies Gleave 2000), with the use of images preferred over photographs due to the ability to more easily control for background elements (e.g. weather and lighting) that could otherwise unintentionally impact on respondents' answers (Swanson et al. 1997).

Where revealed preference surveys are undertaken, **interaction effects should be controlled for where possible**. While this is often difficult to achieve in practice, Yoh et al. (2011) demonstrated how interactions between amenities (e.g. stations with security staff also having less graffiti) could be minimised by surveying users across a sufficiently heterogeneous sample of stops and stations that contain a mix of attributes that run counter to the typical correlations found among amenities.

The **adoption of rating scales** to support the valuation of public transport customer amenities has been suggested in the literature given the lack of any natural measurement units for amenities (OECD & ITF 2014; Wardman & Whelan 2001). Moreover, when combined with stated preference, rating scales can avoid the need for any 'capping' or downward scaling of values that may arise due to the packaging effect (Douglas 2015; Robson 2009).

A final element of best practice that was identified in the literature relates to the **careful application of benefit/value transfer**. The selection of values should give due consideration to the validity and reliability of underlying studies, with values adjusted (e.g. for income differences) as necessary to better reflect the local study context (Brouwer 2000). In converting monetary values to the desired currency and year, Purchasing Power Parity (PPP) adjusted exchange rates should be used to better control for distortions in economic values (de Groot et al. 2012). Careful consideration also needs to be given to ensuring that benefits are not double-counted by avoiding the application of values for amenities that overlap (DEFRA 2007). Finally, given the sensitivity of values to specific contexts, a range of values should be ideally presented with primary valuation research undertaken where amenities form a major component in the justification of a project (Booz Allen & Hamilton 2000).

9. Additional Items of Interest to Transport for Victoria

This section of the report covers additional items of interest raised by Transport for Victoria during a workshop held in November 2017 on an earlier draft of this report. All items relate to previous amenity valuation studies and whether they considered the following:

1. If and how customer amenity values change by journey length
2. Variation in values across key customer segments, e.g. mobility impaired, elderly, gender
3. Marginal improvements to amenities, e.g. moving from a 40% to 80% improvement
4. Repeated valuations of the same amenities over time, including evidence of any decay in values.

To explore these issues, the same base of literature outlined in Section 3 was reviewed again. A synthesis of results is presented in the following sub-sections. Given the contextual differences associated with valuation studies that have been undertaken, specific values are not presented. Rather, an overview of general findings and trends is provided.

9.1 Valuations by journey length

Only two studies that were reviewed provided valuations for individual public transport customer amenities by journey length. These included a study by Cuthbertson et al. (1993) in the United Kingdom on valuing the benefit of rail station improvements and work undertaken by Douglas Economics (2006), also reported in Douglas and Karpouzis (2006), on valuing both station and train related attributes in New South Wales, Australia. Other studies such as Copley et al. (1998) incorporated journey length as an attribute in stated preference surveys, but did not segment values on this basis.

In valuing the benefit of station improvements, Cuthbertson et al. (1993) segmented customer amenity values into three distance categories: 0-10 km, 10-40 km and 40+ km. In all cases, station improvements were valued higher with increasing journey length. A subsequent analysis of the values reported in the study showed that on average, individual amenities were valued 2-3 times higher for long distance trips (40+ km) than short distance trips (0-10 km), and were valued around 30% higher for medium distance trips (10-40 km) compared to short distance trips (0-10 km).

In the study undertaken by Douglas Economics (2006), customer amenity values were segmented into three journey length categories: short (on-board train trips less than 25 minutes), medium (25-59 minutes) and long (≥ 60 minutes). Consistent with the findings of Cuthbertson et al. (1993), amenities were valued higher with increasing journey length. A subsequent analysis of the values reported in the study showed that overall station and train improvements were valued at around 4-5 times higher for long trips (≥ 60 minutes) compared to short trips (< 25 minutes), and around 2-3 times higher for medium trips (25-59 minutes) compared to short trips (< 25 minutes).

In research reported by Project for Public Spaces and Multisystems Inc. (1999) in the United States, public transport users undertaking longer trips were found to value security cameras, information and comfortable on-board seating more than those undertaking short trips. Research undertaken in New Zealand (Douglas 2016a) also showed that passengers undertaking longer trips tend to place greater importance on toilet availability/cleanliness and lighting. However, no individual amenity values segmented by journey length were reported in these studies.

Finally, and while not part of the initial base of literature reviewed, draft transport and assessment planning guidelines prepared by the Transport and Infrastructure Council (2017) suggest that values can be applied to different trip lengths when they are expressed as a proportion of in-vehicle travel time.

9.2 Valuations by key customer segments

A number of studies, albeit relatively few, reported valuations by key customer segments, including age, gender, users vs. non-users, user class, trip purpose, trip frequency and time period. A summary of key findings is provided in Table 8. Extensive customer segmentation was also undertaken by Douglas (2016a) but no specific valuations were reported in this study.

Table 8: Summary of valuations by key customer segments

Customer segmentation	Key findings
Age	• For tram related amenities, values reported by Booz Allen Hamilton (2006) for shelter, seating, raised platforms, audio announcements and customer staff were highest among those aged 55+ years, while values for ticket machines, route/timetable information and real-time displays were lower among 55+ year olds compared to younger users
Gender	• For tram related amenities, values reported by Booz Allen Hamilton (2006) for seating, raised platforms, lighting and audio announcements were higher among females • Preston et al. (2008) found that females placed greater value on station enhancements, particularly those related to personal security and ambience • Project for Public Spaces and Multisystems Inc. (1999) found that females were more concerned about bus stop lighting, security cameras, driver courtesy and low floor buses
Users vs. non users	• Valuations for bus related amenities (information, security, driver manner) among car users reported by Accent (2002) were generally around 10-15 times higher than bus users, although Robson (2009) reported values for similar bus related amenities at only 25% higher among car users compared to bus users
User class	• For train related amenities on intercity services, Steer Davies Gleave (2000) reported valuations for first class passengers that were approximately 50% higher than business class passengers and around twice as high as standard class passengers, although much variation in values is found across individual amenities
Trip purpose	• Values for bus related amenities (seating, noise, appearance) reported by Phanikumar and Maitra (2006) were around 10% higher for non-commuting trips than commuting trips • Valuations for interchange station facilities by business and leisure travellers reported by Balcombe et al. (2004) were approximately 2-3 times higher than commuters; conversely, valuations of rolling stock related amenities reported by Wardman and Whelan (2001) among commuters were 2-3 times higher than business and leisure travellers • Valuations of rail station enhancements reported by Preston et al. (2008) were 10-15% higher among business and leisure travellers compared to commuters
Trip frequency	• Valuations for train related amenities reported by Booz Allen Hamilton (2007) among infrequent users were approximately 15% higher than frequent users, although values reported by Halcrow (2005) suggest that irregular users value train related amenities up to 2-3 times higher than regular users • Project for Public Spaces and Multisystems Inc. (1999) found that frequent users were more interested in driver courtesy and on-board information compared to infrequent users
Time period	• Valuations for rail vehicle amenities reported by Douglas Economics (2006) suggest that values are generally 30% higher for off-peak trips compared to peak trips, while rail station related amenities are around 15% higher for off-peak trips compared to peak trips • For train related amenities, Halcrow (2005) reported values for cleanliness aspects that were 20-40% higher for off-peak and weekend trips (compared to peak trips) and values for car parking aspects that were 20-50% higher for peak trips

Source: Authors' synthesis and analysis of valuation data reported in the literature

While the findings in Table 8 are largely context dependant and subject to considerable variation, a number of general conclusions can be drawn as follows:

- Older passengers tend to place greater value on amenities such as shelter, seating, raised platforms, audio announcements and customer staff
- Females generally value personal security related amenities more than males
- Car users tend to value amenities much higher than bus users, as do first class passengers when compared to standard class passengers
- Valuations among non-commuters are generally higher than commuters, although some contrary evidence of this exists in the context of rolling stock valuations (Wardman & Whelan 2001)
- Infrequent public transport users tend to place a higher value on customer amenities than frequent users; similarly, amenities are valued higher for off-peak trips compared to trips made in the peak.

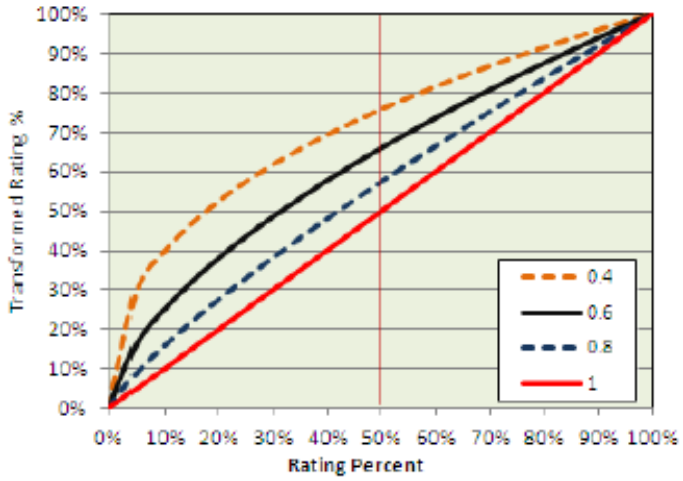
No studies that were reviewed provided valuations of customer amenities solely from the perspective of mobility restricted passengers. As part of a valuation study of public transport universal design measures in Norway, Fearnley et al. (2011) noted the difficulty of obtaining robust willingness to pay values for people with special needs given the relatively small proportion they comprise in relation to all passengers. However, they do note that among passengers who reported movement problems (defined as those who indicated movement limitations, use of a walking stick or crutches, pregnancy, big/heavy luggage, many shopping bags, trolley or small children), willingness to pay for a low floor vehicle and kerb at a bus stop was close to twice as high of that of all passengers. In addition, and while not part of the initial base of literature reviewed, draft guidelines prepared by the Transport and Infrastructure Council (2017) suggest the use of a higher value for passenger lifts at rail stations by wheelchair and other mobility challenged users (0.13 minutes) compared to those without mobility challenges (0.08 minutes).

9.3 Valuations of marginal improvements to amenities

A relatively small number of studies that were reviewed had provided valuations for different levels of improvement in the quality of amenity provision (Copley et al. 1998; Fearnley et al. 2011; Transport for London 2014). In these studies, each level of improvement in amenity provision was usually described in qualitative terms (e.g. basic toilet facilities vs. modern toilet facilities).

However, studies predominantly undertaken by Neil Douglas throughout Australia and New Zealand have estimated the value of marginal improvements to amenity provision using a more quantitative approach (Douglas Economics 2006; Douglas Economics & Sweeney Research 2014; Douglas 2016a; Douglas & Jones 2016; Douglas & Karpouzis 2006). The methodology employed by Neil Douglas involves the use of rating surveys to ascertain perceived levels of quality in existing amenity provision in percentage terms (e.g. 40%). Valuations are then estimated for marginal improvements to amenity provision, usually in 10% increments up to 100%. Improving the rating from 40% to 80% is considered to represent a range from low quality to high quality. Importantly, values do not increase linearly with improvements in amenity provision; a power function is used such that a change from poor (25%) to average (50%) quality is valued higher than a change from average (50%) to good (75%) quality. An example of the power function from Douglas (2016a) is shown in Figure 3.

Figure 3: Example of power function used to transform quality ratings



Source: Douglas (2016a)

9.4 Repeated valuations including any evidence of decay

No studies that were part of the initial base of literature provided any evidence of repeated valuations of the same amenities in the same context over time, or any evidence of decay in values over time. However, draft guidelines prepared by the Transport and Infrastructure Council (2017) that were subsequently available point to evidence from New Zealand which estimates the decay in value of a major station upgrade (typically involving the rebuilding of the main station building) over time by combining the results of two near identical passenger station rating surveys undertaken ten years apart. Upon opening, the station upgrade was valued at 3.35 minutes (in equivalent in-vehicle time) and gradually decreased to 2.01 minutes after five years and 0.32 minutes after ten years. This relationship is almost a perfect linear straight line decline in value suggesting station life amenity value of just over 11 years and an amenity value half-life of 5 years with a half-life value of 2.01 minutes (63% of the value of its station opening value).

These observations have important implications for the handling of amenity values in economic appraisals. How long should an amenity value be applied? What value represents an 'average' value? However there is only a single data point on which to rely for answers to these questions. Clearly these is much scope to improve knowledge in this area.

10. Research Gaps

While a significant body of research has contributed to understanding the value placed on public transport customer amenities, a number of key knowledge gaps remain which should be addressed in future research. Research gaps and opportunities in the field of valuing public transport customer amenities, as identified by the authors, are detailed in Table 9.

Most public transport customer amenity valuation studies were conducted more than 10 years ago with limited reporting of values by key market segments. New primary research is needed to address this issue, particularly given changes in customer expectations and the relevance of amenities over time (Robson 2009). In doing so, studies should also seek the value of customer amenities from the perspective of non-users, particularly those who are deterred from using public transport due to perceptions of insufficient quality in amenity provision (Fearnley et al. 2011; Frei et al. 2015).

There are also valuations of specific amenities that have been noted by the literature as being particularly limited to date. These include those related to personal security (Fearnley et al. 2015; Paulley et al. 2006), wireless free internet (Wi-Fi) (Dong et al. 2015; Zhang et al. 2006) and mobile phone charging points. Furthermore, only a very limited number of studies to date have valued tram

based amenities, with no specific studies sourced for this literature review that considered the valuation of ferry based amenities.

Knowledge of the factors that influence customer amenity valuations is currently very limited. A meta-analysis of valuations undertaken to date could assist in meeting this gap. A regression based approach could be adopted to help identify significant factors that affect the magnitude of values. However, this relies on having a sufficient sample of size of valuations in units that are either consistent or in units that can be easily converted without compromising the accuracy of original values (Li & Hensher 2011).

Other research gaps identified include the need to formally test how well respondents' understand different levels of amenity provision used in choice experiments (Robson 2009) as well as assessing the credibility of attribute levels to determine whether they are appropriate for what is being measured (Wardman & Whelan 2011). There is also a need to understand how benefit/value transfer can be used in a more systematic and appropriate way for valuing public transport customer amenities. As noted by DEFRA (2007), a better understanding is needed of when the method works and when it does not, as well as a review of options that may improve the accuracy of benefit/value transfer.

Table 9: Research gaps and opportunities in the valuation of public transport customer amenities

Research gap	Research opportunity
Most valuations of customer amenities are now very dated with limited reporting of values by key market segments	Institute a new program of primary research to value public transport customer amenities on a regular basis, by key market segments
There is little understanding of the value placed on amenities by non-users	Include non-public transport users in future primary valuation studies
Valuations of personal security related amenities are limited	Conduct a primary valuation study to understand the value placed on personal security related amenities, with segmentation by key groups (e.g. gender, attitudes, cultural factors)
Very little empirical research is available on the value of Wi-Fi and mobile phone charging points	Conduct a primary valuation study, with respondents segmented, to understand the value placed on Wi-Fi and mobile phone charging points
Valuations of tram based customer amenities have been limited, particularly those related to the access/egress and in-vehicle stages of the journey	Conduct a primary valuation research study, with respondents segmented, to understand the value placed on more tram based amenities, particularly those related to the access/egress and in-vehicle stages of the journey
There is little understanding of the value of customer amenities relating to ferries	Conduct a primary valuation research study, with respondents segmented, to understand the value placed on various ferry based amenities
Knowledge of factors affecting the magnitude of amenity values is limited	Conduct a meta-analysis of valuations undertaken to date, using a regression model to identify significant factors affecting the magnitude of values
Respondents' understanding of levels of amenity provision is seldom tested	Assess variability in respondents' understanding of levels of amenity provision with a view to improving the way in which such levels are framed
There is a limited understanding of how benefit/value transfer can be used in a more systematic and appropriate way	Review studies that have used benefit/value transfer in the context of public transport customer amenities; identify options for improving the use of this method through potentially drawing on the environmental valuation literature

Source: Authors' synthesis

11. Discussion and Conclusion

The aim of the literature review underlying this report was to synthesise existing research and practice relating to the valuation of public transport customer amenities. In doing so, six key objectives were identified to assist in achieving this aim. A brief summary of the results associated with each objective, including a discussion of their implications, is provided below.

Objective 1: To develop a typology of customer amenities for key stages of the public transport journey

A total of 97 public transport customer amenities were identified in the literature. These were classified into one of six types (access, facilities, information, security, environment and condition) across four key stages of the public transport journey (access/egress, waiting, boarding/alighting and in-vehicle). Most of the amenities were relevant to the waiting stage of the journey, although some are becoming less relevant to customers (e.g. public telephones) with advances in digital and communications technology. Nevertheless, the sheer number of possible amenities available to customers can pose considerable challenges for understanding their contribution to the public transport journey, particularly in light of differing contexts and circumstances.

Objective 2: To understand methods used to estimate and apply customer amenity values

Six main methods were identified in the literature for estimating and applying customer amenity values: stated preference, revealed preference, customer ratings, priority evaluator, maximum difference scaling and benefit/value transfer. Stated preference has been the dominant method used to estimate customer amenity values to date, although customer ratings have also been relatively common. The literature points to the attraction of using customer ratings given the lack of any natural or meaningful units for customer amenities. Efforts to combine stated preference with customer ratings are seen as preferable over using either method in isolation. While revealed preference has the distinct advantage of practically eliminating measurement error, difficulties in controlling for external factors may mean that the use of this method for estimating the value of customer amenities is unlikely to become dominant, at least in the near future.

Objective 3: To synthesise existing values to understand their relativities and variability

A synthesis of existing customer amenity values highlighted considerable variability, with a skew towards individual values of less than two minutes of equivalent in-vehicle time. The presence of a relatively small number of very high values suggests that the use of medians, rather than averages, is likely to be more appropriate for reporting syntheses of customer amenity values. The findings also highlight the importance of taking into account differences in location, study design and other contextual factors given these can heavily influence the magnitude of values. While there was very little in the way of any clear pattern in the values, higher values were generally found for the in-vehicle stage of the public transport journey.

Objective 4: To identify key issues associated with the valuation of public transport customer amenities

A range of both strategic and tactical issues associated with the valuation of public transport customer amenities were identified in the literature. Of particular note is the extensive range of contextual factors that can influence the level of variability in values. Changes in customer expectations, along with the relevance of certain amenities over time, point to the need to regularly update valuations to ensure their relevance can be maintained. An additional issue identified in the literature relates to valuations being expressed in different units, thereby limiting the ability to compare values across studies. This was indeed an issue faced by the authors in assembling existing customer amenity values. A potential direction for the future could therefore be to move towards the establishment of guidelines for valuing public transport customer amenities, with the development of a searchable online database of valuations. This approach has been successfully adopted in the field of valuing ecosystem services (de Groot et al. 2012; DEFRA 2007) and could offer considerable benefit to those in the public transport field.

Objective 5: To understand best practices in valuing public transport customer amenities

The literature was relatively silent on best practices in valuing public transport customer amenities. Despite this, key elements that were considered to support best practice included segmenting customers in valuation studies, ensuring respondent familiarity with amenities that are presented, controlling for interaction effects, adopting rating scales, and applying benefit/value transfer with

care. While these elements should be incorporated into future valuation studies, a better understanding of best practices is still needed. This should be explored in future research, with input sought from key practitioners and academics in the field.

Objective 6: To identify key knowledge gaps in the field and opportunities for future research

A number of key knowledge gaps in the field of valuing public transport customer amenities were identified as promising areas for future research. Much of these relate to the need for new primary valuation studies to be undertaken, although scope now arguably exists to undertake some form of meta-analysis of existing values to better understand the factors that influence their relative magnitude. In light of the growing number of valuations available, there is also merit in better understanding how benefit/value transfer can be used in a more systematic and appropriate way.

In closing, this report has provided an important contribution to the literature through an international synthesis of existing research and practice relating to the valuation of public transport customer amenities. Continued research in this field is needed to improve our understanding of the relative value of customer amenities and the most suitable means for measuring their value into the future.

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Appendix A: Key contacts in the field of public transport customer amenity valuations

Name	Organisation	Location
Richard Balcombe	Transport Research Laboratory (TRL) – *now retired?*	United Kingdom
Robin Barlow	NineSquared	Australia
John Bates	John Bates Services	United Kingdom
Abigail Bristow	University of Surrey	United Kingdom
Toby Cuthbertson	SYSTRA	United Kingdom
Neil Douglas	Douglas Economics	New Zealand
Nils Fearnley	Institute of Transport Economics	Norway
David Hensher	University of Sydney	Australia
Peter Jones	University College London (UCL)	United Kingdom
George Karpouzis	*Retired*	Australia
James Laird	University of Leeds	United Kingdom
Roger Mackett	University College London (UCL)	United Kingdom
Peter Mackie	University of Leeds	United Kingdom
Bhargab Maitra	Indian Institute of Technology Kharagpur	India
John Nellthorp	University of Leeds	United Kingdom
Maren Outwater	Resource Systems Group (RSG)	United States
Neil Paulley	*Retired*	United Kingdom
Chintakayala Phanikumar	University of Leeds	United Kingdom
John Preston	University of Southampton	United Kingdom
Jeremy Shires	University of Leeds	United Kingdom
Stephen Stradling	Edinburgh Napier University	United Kingdom
Mark Streeting	LEK Consulting	Australia
Ryan Taylor	Transport for London	United Kingdom
Mark Wardman	SYSTRA	United Kingdom
Gerard Whelan	KPMG	United Kingdom
Allison Yoh	University of California	United States

Source: Authors' synthesis

Appendix B: Detailed summary of existing public transport customer amenity values

ID	Amenity	Amenity type						Median value (range in brackets): in-vehicle minutes		
		Access	Facilities	Information	Security	Environment	Condition	Train	Tram	Bus
ACCESS/EGRESS										
AE1	Bicycle parking outside station/stop	✓	✓					0.31 (0.02 - 0.60)	-	-
AE2	Building exterior of station/stop						✓	0.10	-	-
AE3	Car parking		✓					0.36 (0.01 - 1.80)	-	-
AE4	Directional signage to station/stop			✓				-	-	0.68 (0.37 - 0.98)
AE5	Entrance visibility to station/stop	✓						-	-	0.50
AE6	Lighting				✓			-	-	0.57
AE7	Pedestrian crossing	✓						-	-	-
AE8	Onwards connections outside station/stop	✓						0.07 (0.01 - 0.60)	-	0.35
AE9	Step free access to station/stop	✓						0.64 (0.15 - 0.93)	-	1.02
AE10	Taxi rank outside station/stop	✓						0.16 (0.01 - 0.30)	-	-
AE11	Wide ticket barrier gates	✓						-	-	0.10
WAITING										
W1	Air quality					✓		-	-	-
W2	Appearance of station/stop						✓	0.20 (0.06 - 1.80)	-	0.18 (0.03 - 1.27)
W3	Art						✓	-	-	-
W4	ATMs		✓					-	-	-
W5	Cabling						✓	-	-	-
W6	Cleanliness of station/stop				✓		✓	0.50 (0.13 - 13.99)	1.21	0.39 (0.10 - 2.07)
W7	Clocks			✓				0.20 (0.20 - 0.20)	-	0.10
W8	Draughts					✓		-	-	-
W9	Directional signage			✓				0.30 (0.05 - 1.80)	-	1.20
W10	Electronic displays/real-time information			✓				2.75 (0.12 - 6.00)	0.48 (0.30 - 0.65)	0.99 (0.10 - 10.95)
W11	Escalators	✓	✓					0.12 (0.03 - 0.20)	-	-
W12	Graffiti				✓		✓	0.30 (0.05 - 0.97)	-	0.46 (0.10 - 0.55)
W13	Ground/floor surfacing						✓	1.07 (0.63 - 1.50)	-	-
W14	Help point			✓	✓			0.67 (0.08 - 3.96)	-	0.10
W15	Information/emergency button			✓				0.35 (0.03 - 1.80)	-	0.75 (0.50 - 1.60)
W16	Information on outside of vehicle			✓				-	-	-
W17	Information on system disruptions			✓				1.00 (0.10 - 2.12)	-	1.12 (0.93 - 1.31)
W18	Lifts	✓	✓					0.22	-	-
W19	Lighting				✓			0.40 (0.03 - 7.93)	0.35 (0.22 - 0.48)	0.54 (0.10 - 1.20)
W20	Litter				✓		✓	0.50 (0.32 - 0.91)	-	0.22 (0.14 - 0.24)
W21	Luggage storage		✓					-	-	-
W22	Map of local surrounding area	✓		✓				-	-	0.87 (0.20 - 1.74)
W23	Map of public transport routes	✓		✓				-	-	0.61 (0.20 - 0.66)

ID	Amenity	Amenity type						Median value (range in brackets): in-vehicle minutes		
		Access	Facilities	Information	Security	Environment	Condition	Train	Tram	Bus
W24	Map of station area	✓		✓				-	-	-
W25	Mirrors				✓			0.02	-	-
W26	Mobile phone real-time information			✓				-	-	0.16 (0.12 - 0.20)
W27	PA system			✓	✓			0.32 (0.05 - 2.33)	0.16	0.99 (0.16 - 1.81)
W28	Photo booth		✓					-	-	-
W29	Police				✓			1.09 (0.96 - 1.23)	-	-
W30	Posters			✓			✓	-	-	-
W31	Public telephones		✓				✓	0.16 (0.01 - 2.00)	-	0.49 (0.10 - 0.67)
W32	Retail/food outlets		✓					0.19 (0.05 - 0.90)	-	0.35 (0.30 - 0.40)
W33	Rubbish bins		✓					-	-	-
W34	Seating		✓				✓	0.40 (0.04 - 4.80)	0.43 (0.32 - 0.54)	0.60 (0.10 - 13.78)
W35	Shelter/platform canopy		✓				✓	0.40 (0.00 - 9.40)	0.52 (0.48 - 0.55)	0.81 (0.14 - 1.70)
W36	Staff*			✓	✓			0.57 (0.09 - 12.01)	0.09	0.24 (0.13 - 1.10)
W37	Step free access	✓						-	-	-
W38	Surveillance cameras				✓			1.02 (0.06 - 5.83)	-	0.99 (0.30 - 2.91)
W39	Temperature control (heating/cooling)					✓		0.20 (0.11 - 0.29)	-	1.98
W40	Timetables			✓			✓	1.52 (1.20 - 1.52)	0.31	0.74 (0.40 - 1.09)
W41	Ticket machines		✓				✓	0.21 (0.10 - 0.30)	0.33	-
W42	Ticketing options		✓					0.40 (0.16 - 0.66)	0.51	0.20 (0.10 - 1.43)
W43	Ticket office		✓	✓				0.30 (0.16 - 1.20)	-	-
W44	Toilets		✓				✓	0.33 (0.01 - 7.93)	-	0.46 (0.22 - 0.70)
W45	Waiting room		✓		✓	✓	✓	0.64 (0.03 - 1.35)	-	-
W46	Wi-Fi access		✓					-	-	-
BOARDING/ALIGHTING										
BA1	Automatic doors		✓					-	-	-
BA2	Cleanliness of vehicle exterior				✓		✓	0.38	-	0.03 (0.02 - 0.10)
BA3	Décor of vehicle exterior						✓	0.38 (0.15 - 0.40)	-	-
BA4	Graffiti on vehicle exterior				✓		✓	-	-	-
BA5	Hand rails	✓						-	-	-
BA6	Step free access to vehicle	✓						0.22 (0.08 - 1.50)	0.24	1.33 (0.05 - 5.59)
BA7	Vehicle 'newness'						✓	3.34 (0.78 - 10.61)	-	1.57
IN-VEHICLE										
IV1	Access between carriages	✓			✓			3.72 (3.04 - 4.39)	-	-
IV2	Ability to see between carriages				✓			-	-	-
IV3	Cleanliness of vehicle interior				✓		✓	0.37 (0.14 - 9.72)	-	1.44 (0.30 - 9.78)
IV4	Customer alarms				✓			-	-	-
IV5	Driver (attitude, helpfulness)			✓	✓	✓		-	-	0.51 (0.02 - 4.91)
IV6	Electronic displays/real-time information			✓				0.70 (0.24 - 6.88)	-	0.69 (0.10 - 11.35)

ID	Amenity	Amenity type						Median value (range in brackets): in-vehicle minutes		
		Access	Facilities	Information	Security	Environment	Condition	Train	Tram	Bus
IV7	Environmental impact of vehicle					✓		0.59	-	13.43
IV8	Food service on-board		✓					0.09	-	-
IV9	Gangways	✓	✓					-	-	-
IV10	Graffiti on vehicle interior				✓		✓	3.30 (0.08 - 6.53)	-	0.20
IV11	Graffiti alongside track/route				✓		✓	-	-	-
IV12	Hand rails	✓						0.99 (0.47 - 1.52)	-	0.40 (0.19 - 0.61)
IV13	Lighting				✓			0.41 (0.13 - 0.96)	-	-
IV14	Litter				✓		✓	-	-	0.72 (0.40 - 0.84)
IV15	Luggage storage		✓					-	-	0.28 (0.20 - 0.35)
IV16	Map of public transport routes			✓				-	-	0.20 (0.20 - 0.68)
IV17	Multi-purpose areas within vehicle	✓	✓					-	-	-
IV18	Noise					✓		0.32 (0.22 - 0.35)	-	3.24 (0.48 - 3.74)
IV19	Odour					✓		-	-	-
IV20	PA system			✓	✓			1.24 (0.16 - 3.85)	-	1.22 (0.16 - 9.81)
IV21	Posters			✓			✓	-	-	-
IV22	Power outlets		✓					-	-	-
IV23	Ride quality					✓		1.20 (0.30 - 4.66)	0.50	0.85 (0.00 - 4.09)
IV24	Seating		✓				✓	0.83 (0.05 - 1.75)	-	0.53 (0.02 - 2.21)
IV25	Smoothness of driving					✓		0.68 (0.10 - 1.42)	0.50	0.80 (0.05 - 1.84)
IV26	Staff (non-driver)			✓	✓			1.60 (0.56 - 3.85)	-	-
IV27	Surveillance cameras				✓			2.00 (0.37 - 2.20)	-	0.70 (0.32 - 2.54)
IV28	Temperature control (heating/cooling)					✓		1.50 (0.15 - 6.79)	0.39	1.00 (0.55 - 1.24)
IV29	Toilets		✓				✓	0.60 (0.60 - 0.60)	-	-
IV30	Ventilation					✓		1.84 (0.82 - 2.87)	0.22	0.44 (0.10 - 0.44)
IV31	Wheelchair/buggy space	✓						-	-	0.14 (0.10 - 0.19)
IV32	Wi-Fi access		✓					-	-	-
IV33	Windows				✓		✓	-	-	0.35 (0.30 - 0.39)

Source: Authors' analysis of existing public transport customer amenity values (Accent 2002; Australian Transport Council 2006; Balcombe et al. 2004; Booz Allen Hamilton 2006, 2007; Currie et al. 2013; Douglas Economics 2006; Douglas 2016b; Douglas & Jones 2016; Fearnley et al. 2011; Hensher & Prioni 2002; London Transport 1997; Phanikumar & Maitra 2006; Robson 2009; Steer Davies Gleave 1996, 2000; Transport for London 2014; Travers Morgan undated; Wardman & Whelan 2001).

* 'Staff' can cover a range of different attributes, e.g. staff visibility, knowledge, willingness to help, appearance.

Note: excludes valuations made by intercity rail passengers (Preston et al. 2008; Steer Davies Gleave 2000). '-' indicates that no value was available or amenity is not applicable. Purchasing power parities (OECD 2016) and public transport user values of time (Australian Transport Council 2006) were used to convert values to equivalent units of in-vehicle time (minutes) where needed.