SENSITIVITY TESTING OF ALTERNATIVE PUBLIC TRANSPORT PASSENGER SATISFACTION ANALYSIS TECHNIQUES

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ABSTRACT

This paper investigates alternative methods of analysing public transport user satisfaction and importance rating data. It reviews criticisms of conventional 'importance-performance analysis', as developed and applied in the field of market research over the past three decades, and reports on sensitivity tests undertaken to assess the impact of alternative techniques upon the robustness of resulting recommendations for priority system improvements from a user perspective. The alternative techniques include: the plotting of satisfaction and importance ratings in a 'quadrant model', versus a 'diagonal model'; alternative methods of estimating the most accurate slope of the iso-priority line in 'diagonal models'; and the use of mean ratings, versus the percentage of dissatisfied respondents, in plotting service attribute performance. The sensitivity tests use a (n=993) passenger satisfaction intercept survey dataset, collected from train, bus and minibus-taxi passengers in Cape Town in 2009 using Likert rating scales. The paper explores which analytical techniques hold greatest promise in further measurements of public transport passenger satisfaction planned in Cape Town. It argues that 'diagonal models' produce more reliable prioritisations than 'quadrant models', but that the alternative methods of determining the slope of the diagonal each have weaknesses. The paper discusses the dynamic relationship between satisfaction rating and changing passenger expectations resulting from the implementation of system improvements, and concludes that changes in public transport service provision are likely to result in changes in passenger expectations and satisfaction, rendering longitudinal comparison problematic.

1 INTRODUCTION

Over the past five years investments into public transport infrastructure and systems in larger South African cities have occurred at a scale unprecedented in the democratic era. Important policy questions arising from these investments relate to their impact on the satisfaction levels of users. A paper presented by the authors in 2010 argued that the public transport passenger satisfaction measures applied in the National Household Travel Survey could be improved (Behrens and Schalekamp 2010). More specifically, it was argued that the absence of rating data on the importance of service attributes rendered the interpretation of satisfaction ratings problematic. Following a review of satisfaction measurement methods applied in the field of public transport service provision, the analysis presented in the paper utilised an 'importance-performance analysis' (IPA) approach to data collected in Cape Town in 2009.

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A subsequent review of the more general customer satisfaction literature suggests that improvements on the conventional IPA approach have been made in other fields, but appear to have not yet been applied in the public transport services field. Certainly the manuals issued by the US Transportation Research Board on how to measure customer satisfaction and service quality, while noting some of the limitations discussed later in this paper, present the conventional IPA approach as the only means of plotting satisfaction and importance prioritisations (see TRB 2004:3-25, TRB 1999:17), and more recent summaries of good practice in the field do likewise (see, for instance, Meier and Neugebauer 2009). The primary purpose of this paper is therefore to explore improvements to conventional IPA through tests of the sensitivity of service attribute prioritisations to different techniques, using the Cape Town passenger satisfaction dataset. The findings of these sensitivity tests are intended to inform a further multi-modal survey of passenger satisfaction to be conducted after the launch of the starter phase of the City of Cape Town's Integrated Rapid Transit (IRT) system in 2011. This raises a secondary purpose of the paper – that of exploring the prospects for meaningful comparisons of repeated cross-section passenger satisfaction data.

The paper is divided into four sections. The following section identifies alternative techniques applied in the analysis of satisfaction and importance data. Section 3 describes the Cape Town dataset, and explains the method of sensitivity testing adopted in the study. Section 4 presents and discusses the findings of the sensitivity tests. Section 5 discusses the problem of analysing repeated cross-section satisfaction data. Section 6 concludes with a discussion on the implications of the study findings for the next wave of passenger satisfaction data collection and analysis in Cape Town.

2 ALTERNATIVE TECHNIQUES IN ANALYSING SATISFACTION AND IMPORTANCE DATA

The conventional 'importance-performance analysis' approach to analysing satisfaction and importance data, also referred to as the 'quadrant model', can be attributed to a seminal paper in the field of market research by John Martilla and John James. In it Martilla and James (1977) present a data analysis and plotting technique in which satisfaction and importance rating means for different service attributes are plotted into four quadrants, labelled 'possible overkill', 'low priority', 'keep up the good work', and 'concentrate here'. Bacon (2003) identifies two alternative approaches that have been applied to quadrant delimitation: 'scale-centred'; and 'data-centred'. The former plots quadrants on the basis of the midway point on the rating scale (i.e. three in a five-point Likert scale). The latter plots quadrants on the basis of a data centroid (i.e. a plot of the mean of all satisfaction ratings against the mean of all importance ratings). The 'concentrate here' quadrant clusters service attributes rated as both highest in importance and most dissatisfactory. This data analysis technique enables an identification of those attributes of a product or service that are either most in need of improvement, or conversely candidates for possible cost-saving measures without leading to significant detriment to overall service quality.

Examples of the application of the quadrant model in the field of public transport services are studies by Stradling *et al* (2007) and Beirão and Cabral (2010) (see figure 1). A methodological variation in both of these applications is the use of percentages (i.e. the amount of respondents selecting the final two ratings of a five-point Likert scale are calculated as a percentage of the entire respondent sample) as opposed to means, and the use of 'disgruntlement' (i.e. a cross-tabulation of satisfaction rating against importance rating for each attribute) as opposed to dissatisfaction.

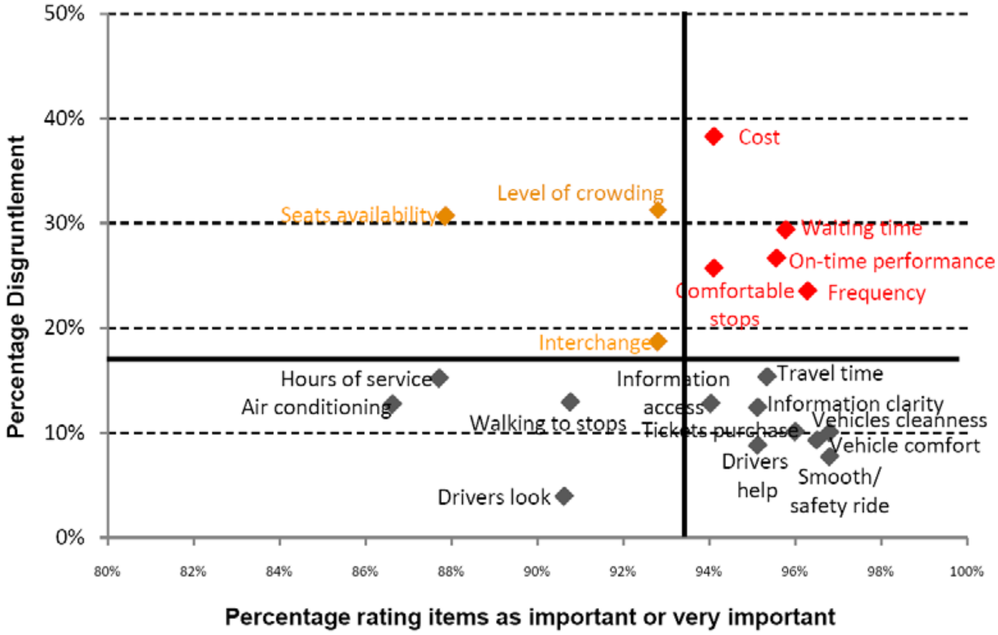


Figure 1. Example of a 'quadrant model' importance-performance analysis (public transport services) (Beirão and Cabral 2010:10)

The simplicity of the quadrant model in application and interpretation led to its widespread use in a variety of fields. It has, however, been subjected to critique. The main criticism relates to an inherent inconsistency in the priorities inferred from the plot, where a slight change in a service attribute's position might lead to a dramatic change in its inferred priority (Bacon 2003, TRB 1999). For example, in figure 1, 'level of crowding' falls outside the 'concentrate here' quadrant because its importance rating falls just below the mean value on the importance axis, but it is the second-ranked most dissatisfactory service attribute. Thus the delimitation of quadrants has been argued to be somewhat arbitrary.[1]

In response to the criticisms of arbitrariness in quadrant delimitation in the quadrant model, 'diagonal models' have been proposed (see, for instance, Abalo 2007 and Bacon 2003). In essence, it is argued that for the purposes of service attribute prioritisation, the iso-priority line runs perpendicular to the diagonal connecting the 'concentrate here' quadrant (i.e. highest importance and dissatisfaction ratings) and the 'possible overkill' quadrant (i.e. lowest importance and dissatisfaction ratings). Two alternative diagonal models are presented in the literature. The first is a hybrid of the quadrant and diagonal model in

[1] A further criticism, not investigated further in this paper, is that all service attributes do not exhibit the same relationships between satisfaction and importance. More specifically, attributes have been grouped into three categories: 'basic factors', 'performance factors' and 'excitement factors'. It is argued that 'basic factors' are more important when system performance is low – they can lead to very low dissatisfaction ratings, but seldom result in very high satisfaction ratings (e.g. there comes a point where improvements in smoothness of ride not longer yield greater satisfaction). It is argued that 'excitement factors' are more important when system performance is high – they can lead to very high satisfaction ratings, but seldom result in very low satisfaction ratings (e.g. on-board internet connection might lead to high satisfaction, but the absence of this attribute might not lead to high dissatisfaction). This has led to the development of a 'three-factor theory of customer satisfaction', also known as the 'Kano model' after its author (see Matzler *et al* 2004 for further discussion).

which the iso-priority diagonal cuts through the data centroid at 45^o (assuming a square plot area and the same value range on the x-and y-axes) creating a triangular ‘concentrate here’ plot area (see figure 2). The second is a model in which the diagonal cuts through the data centroid at an iso-priority line slope determined by a least squares linear regression best fit to the data (see figure 3).

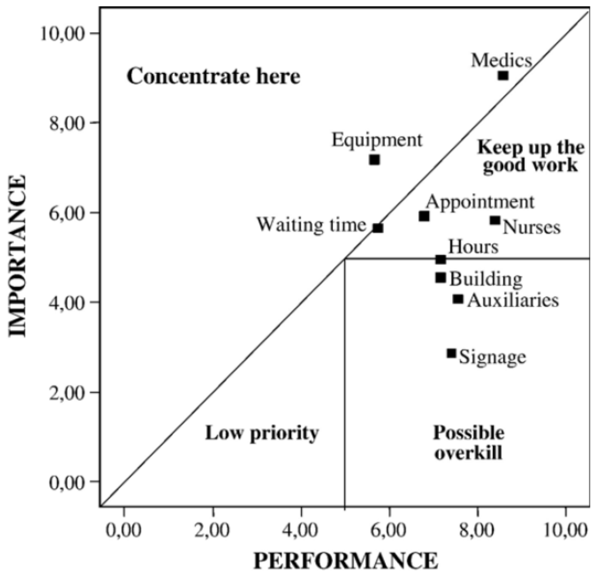


Figure 2. Example of a ‘diagonal model’ importance-performance analysis (health care services) (Abalo *et al* 2007:119)

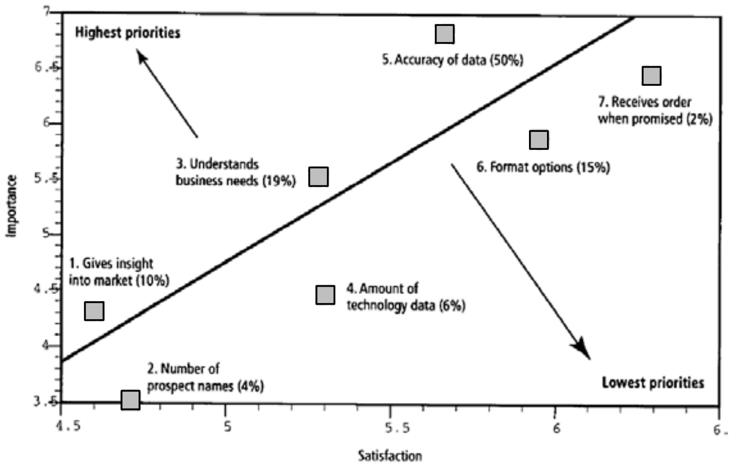


Figure 3. Example of a best fit ‘iso-priority line model’ importance-performance analysis (market research services) (Bacon 2003:67)

3 SENSITIVITY TEST METHOD

Given the alternative applications of, and the emergence of the alternatives to, the quadrant model described above, the sensitivity tests reported upon in this paper focussed on assessing the impacts of the following on service attribute prioritisation:

- plotting service attributes on the basis of mean ratings, compared to the percentage of dissatisfied respondents;
- delimiting prioritised quadrants on the basis of scales, compared to data (and in turn, plotting data-centred quadrants on the basis of mean or 75th percentile values);

- plotting satisfaction and importance ratings in a quadrant model, compared to a diagonal model; and
- plotting diagonal models on the basis of a 45^o slope, compared to an iso-priority line of best fit.

The sensitivity tests were conducted with data collected in 2009 through a (n=993) passenger satisfaction intercept survey at public transport facilities along a ±4 km section of the southern suburbs rail corridor in Cape Town (Behrens and Schalekamp 2010). Data collection began with focus group discussions amongst train, bus and mini-bus taxi users to identify and verify a list of service attributes for inclusion in a short intercept questionnaire. For each public transport mode a slightly modified questionnaire was developed in which a list of service attributes was kept as consistent as possible for comparative purposes. The first part of the questionnaire asked questions relating to respondent age, car access, commute mode, frequency of use, and type of ticket purchased (in the case of train and bus). The second part asked for Likert satisfaction ratings (from 'strongly agree', 'agree', and 'neutral/do not know', to 'disagree' and 'strongly disagree') in relation to a list of 31 to 34 statements (depending on mode) regarding service attributes. Following satisfaction rating, respondents were asked to indicate the importance they attached to the service attribute (from 'very unimportant',' unimportant', and 'neutral/do not know', to 'important' and 'very important'). Data analysis took the form of tabulation of satisfaction and importance ratings, and ranking of service attributes on the basis of performance percentages and means. Appendix A presents the service attribute statements included in the questionnaire, and the mean dissatisfaction and importance ratings that were calculated for each public transport mode.

The method adopted for testing the sensitivity of plots based on mean ratings versus the percentage of dissatisfied respondents took the form of a correlation of the service attribute rankings produced by each rating technique. The method utilised in testing the sensitivity of quadrant delimitation approaches took the form of alternative quadrant overlays and a comparison of included and excluded service attributes. The method adopted to test the sensitivity of service attribute prioritisations based on a quadrant versus a diagonal model took the form of comparison of the number and ranking of attributes produced by each model (calculating the percentage of shared attributes within the prioritisation, and the co-efficient of correlation of the respective rankings), as well as a qualitative assessment of the particular attributes included and excluded. The same method was used to test the sensitivity of alternative iso-priority line slopes in diagonal models.

4 SENSITIVITY TEST RESULTS

With regard to the impact of mean service attribute rating versus percentage rating, table 1 presents coefficients of correlation for each public transport mode dissatisfaction and importance ranking. It was found that ranks were similar (coefficients of correlation ranged between 0.9058 and 0.9905), but not identical. Choice of rating technique does not, therefore, appear to have a significant impact.

Table 1. Correlations between percentage and mean dissatisfaction and importance service attribute ranking, by public transport mode (n=993)

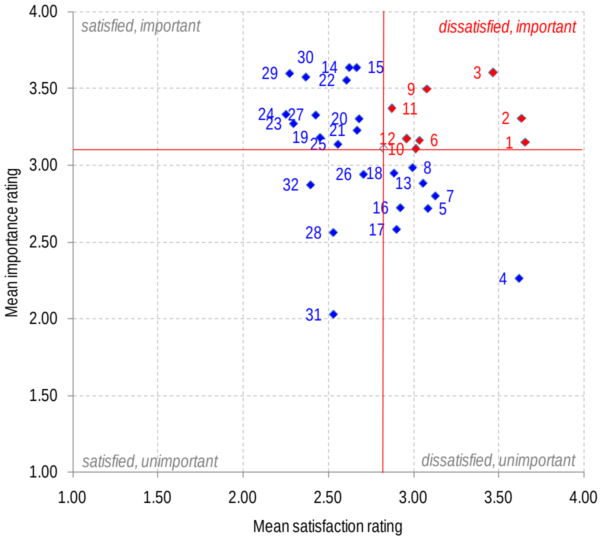
	Train passenger rankings		Bus passenger rankings		Minibus-taxi passenger rankings	
	dissatisfaction	importance	dissatisfaction	importance	dissatisfaction	importance
Co-efficient of correlation	0.9058	0.9846	0.9905	0.9361	0.9443	0.9750

(a) Quadrant model (data centroid)

Number of prioritised service attributes: 8

Rank of prioritised service attributes:

01. in-vehicle security personnel
02. in-vehicle overcrowding
03. seat availability
04. service punctuality
05. station weather protection
06. open doors
07. service frequency
08. seat comfort

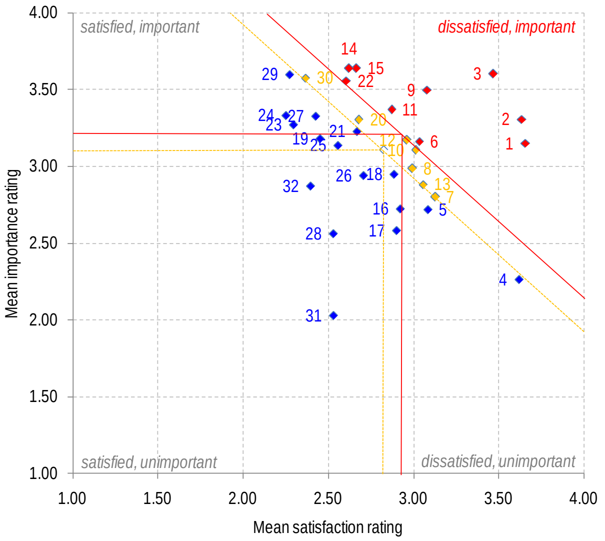


(b) Diagonal model (data centroid and 75th percentile)

Number of prioritised service attributes: 9

Rank of prioritised service attributes:

01. in-vehicle security personnel
02. in-vehicle overcrowding
03. seat availability
04. service punctuality
05. station security personnel
06. vehicle reliability
07. station weather protection
08. open doors
09. in-vehicle security

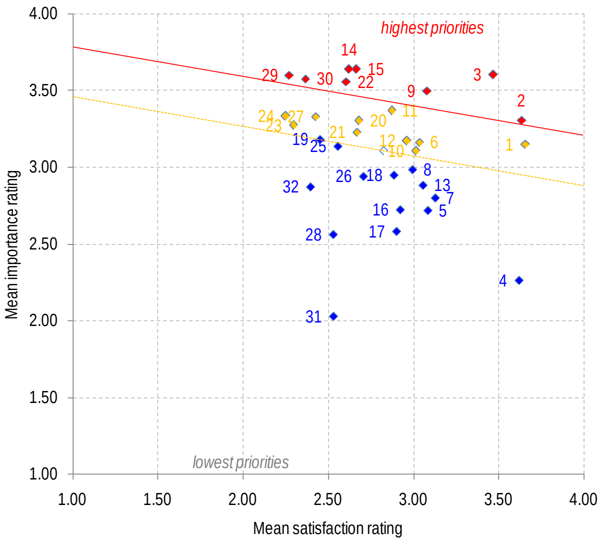


(c) Best fit iso-priority line model (data centroid and 75th percentile)

Number of prioritised service attributes: 8

Rank of prioritised service attributes:

01. in-vehicle security personnel
02. station security personnel
03. vehicle reliability
04. service punctuality
05. in-vehicle security
06. station passenger information
07. station security
08. in-vehicle overcrowding



Legend

1 seat availability
2 in-vehicle overcrowding
3 in-vehicle security personnel
4 graffiti
5 seating density
6 open doors
7 service transfers
8 station seating
9 service punctuality
10 seat comfort
11 station weather protection
12 service frequency
13 station toilets
14 vehicle reliability
15 station security personnel
16 vehicle and station livery
17 passenger politeness
18 in-vehicle staff cust. care
19 ticket purchase
20 station staff customer care
21 vehicle cleanliness
22 in-vehicle security
23 boarding and alighting
24 fare affordability
25 travel speed
26 in-vehicle temperatures
27 station cleanliness
28 train bunching
29 station pax. information
30 station security
31 in-vehicle reading
32 driver behaviour

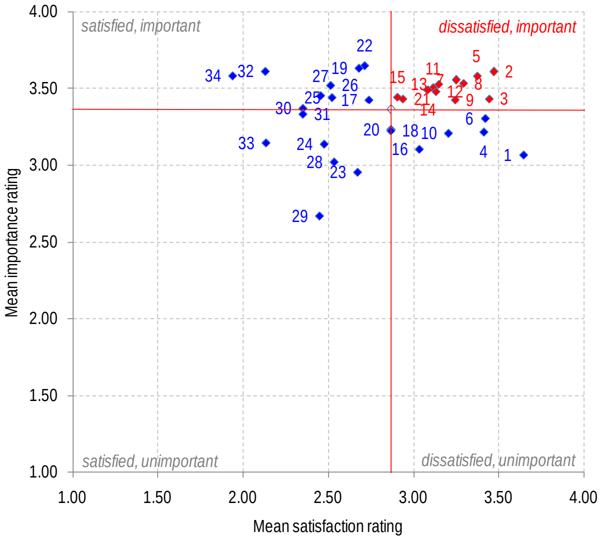
Figure 4. Comparison of prioritised service attributes by analytical technique: Train passengers (n=277)

(a) Quadrant model (data centroid)

Number of prioritised service attributes: 12

Rank of prioritised service attributes:

01. bus stop weather protection
02. service punctuality
03. bus stop seating
04. bus stop passenger information
05. driver behaviour
06. fare affordability
07. in-vehicle overcrowding
08. interchange weather protection
09. seat availability
10. interchange security personnel
11. interchange seating
12. interchange staff customer care

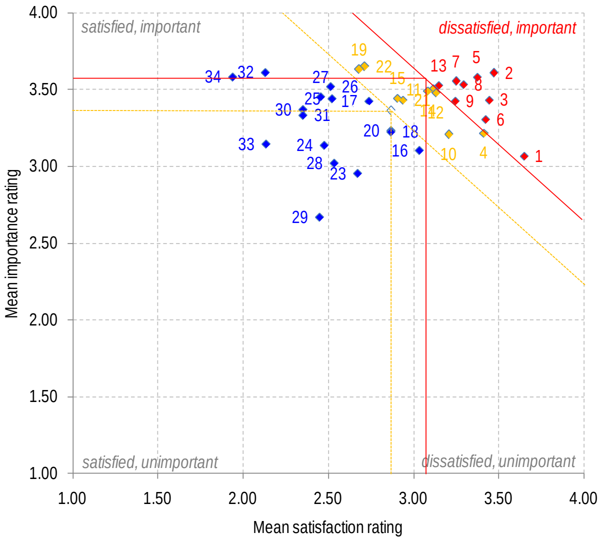


(b) Diagonal model (data centroid and 75th percentile)

Number of prioritised service attributes: 9

Rank of prioritised service attributes:

01. bus stop weather protection
02. service punctuality
03. bus stop seating
04. bus stop passenger information
05. driver behaviour
06. service frequency
07. travel speed
08. fare affordability
09. in-vehicle overcrowding

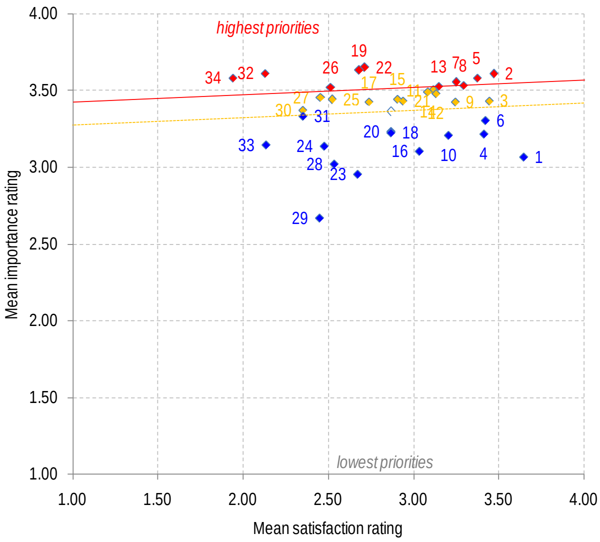


(c) Best fit iso-priority line model (data centroid and 75th percentile)

Number of prioritised service attributes: 9

Rank of prioritised service attributes:

01. vehicle reliability
02. bus stop security
03. interchange security
04. in-vehicle security
05. bus stop weather protection
06. service punctuality
07. interchange pax. information
08. driver behaviour
09. fare affordability



Legend

1 travel speed
2 bus stop weather protection
3 bus stop seating
4 seating density
5 service punctuality
6 service frequency
7 driver behaviour
8 bus stop pax. information
9 in-vehicle overcrowding
10 service transfers
11 PTX weather protection
12 seat availability
13 fare affordability
14 PTX security personnel
15 interchange seating
16 bus bunching
17 bus stop cleanliness
18 interchange toilets
19 bus stop security
20 in-vehicle temperatures
21 PTX staff customer care
22 vehicle reliability
23 vehicle and stop livery
24 ticket purchase
25 seat comfort
26 interchange pax. information
27 vehicle cleanliness
28 passenger politeness
29 in-vehicle reading
30 in-vehicle staff customer care
31 interchange cleanliness
32 interchange security
33 boarding and alighting
34 in-vehicle security

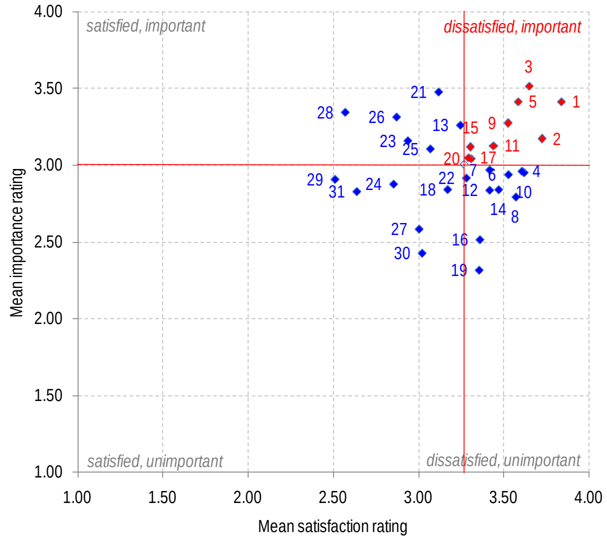
Figure 5. Comparison of prioritised service attributes by analytical technique: Bus passengers (n=240)

(a) Quadrant model (data centroid)

Number of prioritised service attributes: 9

Rank of prioritised service attributes:

01. driver behaviour
02. vehicle reliability
03. rank security personnel
04. in-vehicle overcrowding
05. rank cleanliness
06. seat comfort
07. rank weather protection
08. rank staff customer care
09. law compliance

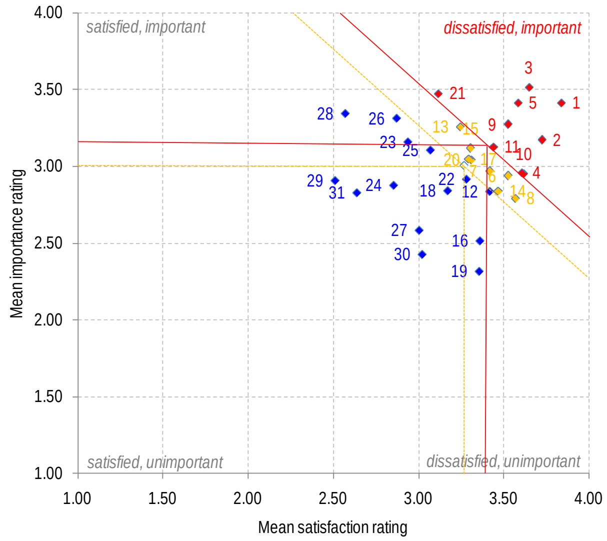


(b) Diagonal model (data centroid and 75th percentile)

Number of prioritised service attributes: 9

Rank of prioritised service attributes:

01. driver behaviour
02. vehicle reliability
03. rank security personnel
04. in-vehicle overcrowding
05. rank cleanliness
06. rank security
07. seat comfort
08. rank toilets
09. ranking seating

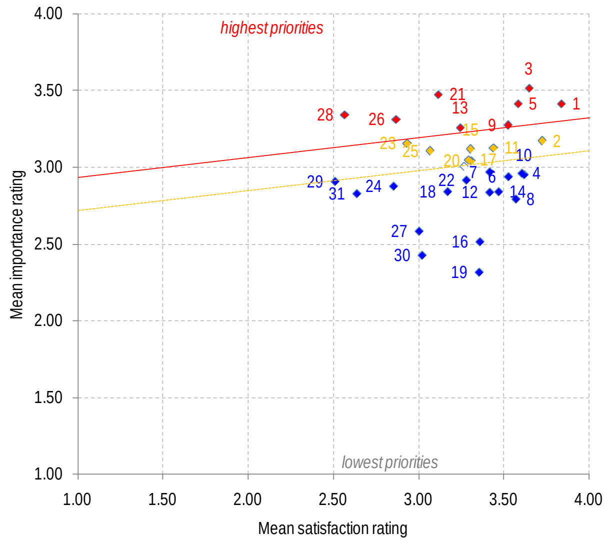


(c) Best fit iso-priority line model (data centroid and 75th percentile)

Number of prioritised service attributes: 8

Rank of prioritised service attributes:

01. rank security
02. vehicle reliability
03. service availability
04. rank security personnel
05. in-vehicle security
06. driver behaviour
07. fare affordability
08. rank cleanliness



Legend

1 driver behaviour
2 in-vehicle overcrowding
3 vehicle reliability
4 ranking seating
5 rank security personnel
6 seating density
7 service transfers
8 in-vehicle music
9 rank cleanliness
10 rank toilets
11 seat comfort
12 in-vehicle waiting
13 fare affordability
14 vehicle and rank livery
15 rank weather protection
16 taxi bunching
17 law compliance
18 journey time reliability
19 in-vehicle reading
20 rank staff customer care
21 rank security
22 in-vehicle staff customer care
23 rank passenger information
24 cash-based fares
25 vehicle cleanliness
26 in-vehicle security
27 in-vehicle temperatures
28 service availability
29 travel speed
30 passenger politeness
31 boarding and alighting

Figure 6. Comparison of prioritised service attributes by analytical technique: Minibus-taxi passengers (n=227)

With regard to the impact of scale- versus data-centred delimitation, figures 4 to 6 illustrate that, in the case of quadrant and diagonal models, a prioritised area based on the midpoint of the rating scale (i.e. three) produced visible differences in attribute selection. It is argued that a data-centred delimitation is superior, as in theory it is possible that in instances of ubiquitously high dissatisfaction or ubiquitously high satisfaction, all attributes could potentially be located inside or outside the prioritised area, thus providing no effective prioritisation.[2] In the case of the alternative diagonal models, it is argued that a 75th percentile value (of attributes ranked by the mean of their satisfaction and importance ratings) is more appropriate than a mean value, as this produces a prioritisation broadly consistent with the quadrant model (i.e. roughly a quarter of service attributes are prioritised). In figures 4(b-c), 5(b-c) and 6(b-c) centroid iso-priority diagonals and quadrants are overlain in orange.

Table 2. Comparison of prioritised serve attributes by analytical technique and public transport mode (n=993)

			Quadrant model		Diagonal model		Best fit model	
			% shared attributes	co-efficient of correlation	% shared attributes	co-efficient of correlation	% shared attributes	co-efficient of correlation
Train pax	quadrant model	% shared attributes	100%		67%		33%	
		co-efficient of correlation		1.000		0.6147		0.2640
	diagonal model	% shared attributes			100%		78%	
		co-efficient of correlation				1.000		0.3653
	best fit model	% shared attributes					100%	
		co-efficient of correlation						1.000
Bus pax	quadrant model	% shared attributes	100%		78%		44%	
		co-efficient of correlation		1.000		0.5862		-0.5227
	diagonal model	% shared attributes			100%		44%	
		co-efficient of correlation				1.000		-0.4934
	best fit model	% shared attributes					100%	
		co-efficient of correlation						1.000
Minibus-taxi pax	quadrant model	% shared attributes	100%		67%		44%	
		co-efficient of correlation		1.000		0.5013		0.0023
	diagonal model	% shared attributes			100%		56%	
		co-efficient of correlation				1.000		-0.3567
	best fit model	% shared attributes					100%	
		co-efficient of correlation						1.000

Note:
Comparisons are of the top nine prioritised service attributes in each category.

With regard to the impact of quadrant versus diagonal models, and of alternative approaches to determining the slope of the iso-priority line in diagonal models, table 2 indicates that quadrant model plots and diagonal model plots shared the greatest proportion of prioritised attributes and had the most closely correlated rankings of prioritised service attributes – between 67% and 78% of the top nine prioritised service attributes were shared, and the highest positive coefficient of correlation was 0.6147. It was found that the best fit iso-priority line model and quadrant model plots shared the least proportion of prioritised attributes, and had the least correlated rankings of prioritised

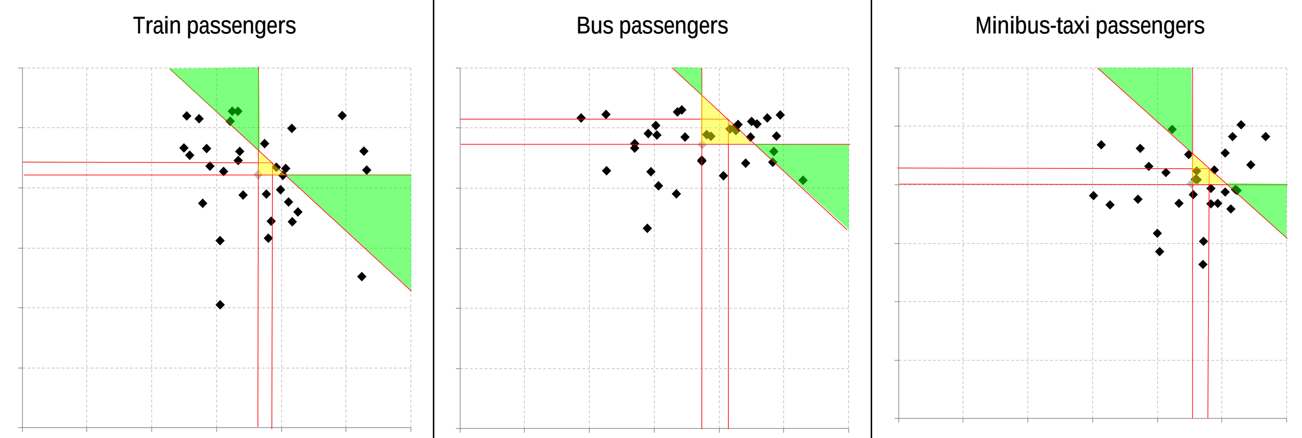
[2] It should be noted, however, that it is theoretically possible to produce a prioritisation from sucha 'scale-centred' plot, by dividing the affected quadrant into a further set of quadrants.

service attributes – in this comparison, between 33% and 44% of the top nine prioritised service attributes were shared, and highest positive coefficient of correlation was 0.2640.

The choice of prioritisation model, therefore, has a very significant effect on the prioritisation of attributes, as does the approach to determining the slope of iso-priority lines in diagonal models.

A more qualitative inspection of the differences between the prioritised service attributes resulting from the alternative analytical techniques (see figures 7 and 8) suggested no particular pattern of attribute gain or loss in the case of the diagonal model replacing the quadrant model (see figure 7), but did suggest a pattern in the case of the best fit iso-priority line model replacing the diagonal model (see figure 8). Here the best fit diagonal, with some exceptions, tended to lose service attributes related to comfort (e.g. seating, weather protection, toilet facilities) and gain more essential service attributes (e.g. security, information, affordability and service reliability). This resulted from best fit iso-priority lines that favoured the higher rated importance attributes over the higher rated dissatisfaction attributes (i.e. slopes became flatter).

Reflecting on the above findings, diagonal models go some way in addressing the criticism of arbitrariness in quadrant IPA models presented earlier in section 2, in that iso-priority lines run in parallel with lines delimiting prioritised areas and therefore they cannot intersect. Thus attributes with equal priority cannot be found on either side of a prioritisation plot area. It is argued, nevertheless, that an element of arbitrariness remains in attribute prioritisation in diagonal models. In the case of iso-priority diagonals with a 45^{o} slope, it is assumed that importance and satisfaction rating are of equal importance to respondents. This may not be the case. In the case of best fit iso-priority diagonals, the slope of the line of best fit is dependent upon the set of service attributes selected for inclusion in the passenger survey. Omitting certain attribute categories could have significant impacts on the slope of the line of best fit.



Train passengers

Gains:
- in-vehicle security
- vehicle reliability
- station security personnel

Losses:
- none

Bus passengers

Gains:
- service frequency
- travel speed

Losses:
- interchange seating
- interchange staff customer care
- interchange security personnel
- interchange weather protection
- seat availability

Minibus-taxi passengers

Gains:
- rank security
- ranking seating
- rank toilets

Losses:
- rank weather protection
- law compliance
- rank staff customer care

Figure 7. Differences in prioritised service attributes resulting from diagonal model analysis compared to quadrant model analysis (n=993)

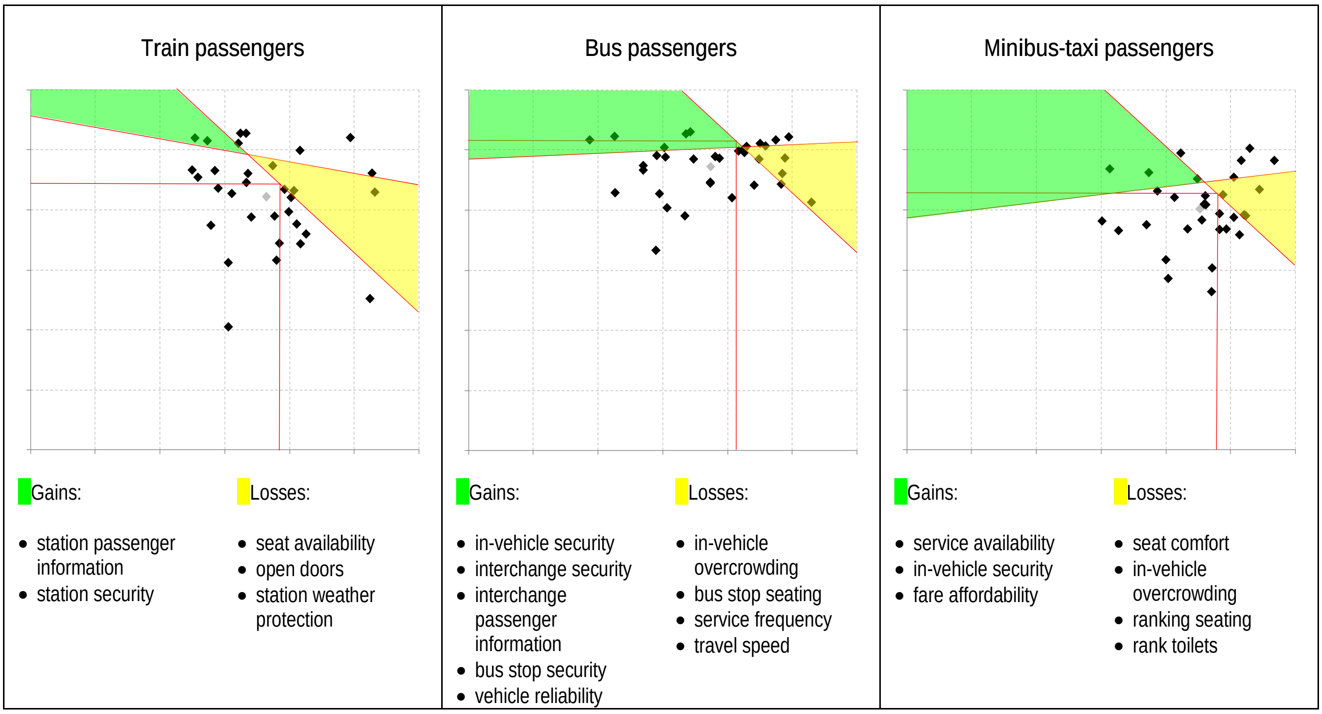


Figure 8. Differences in prioritised service attributes resulting from best fit iso-priority line model analysis compared to diagonal model analysis (n=993)

5 PROBLEMS IN LONGITUDINAL ANALYSIS

Irrespective of the model adopted in attribute prioritisation, a methodological problem common to all approaches is how to understand the impacts of public transport service improvements on passenger satisfaction levels over time. This is of particular interest to South African cities currently planning and implementing bus rapid transit systems. In approving the considerable public funding to construct and operate current and future phases, these cities should have a keen interest in knowing whether existing and potential passengers' levels of satisfaction have increased as a result of this public investment.

Customer satisfaction is widely accepted in the market research field to be the result of a cognitive process in which respondents compare expectations of service quality with perceptions or experience of service quality. The literature posits three main ways in which expectations are formed: through anticipated performance, whereby expectations are set by consumer-defined probabilities of positive or negative outcomes resulting from the consumer engaging in some behaviour (known as 'predictive expectations'); through desired performance, whereby expectations are set by the consumer's preferred level of performance (known as 'normative expectations'); and through the performance of similar or competing brands, whereby expectations are constrained by the level of performance consumers believe is possible based on experiences with other brands (known as 'comparative expectations') (see Zeithaml*et al* 1993 for fuller discussion).

In the first and third cases (predictive and comparative expectations), expectations of public transport service would clearly be directly altered by the introduction of a public transport mode offering an improved quality of service over existing modes. In the second case (normative expectations) is it likely that exposure to a new service offering a higher quality of service will indirectly influence respondents' attitudes towards what is desirable, even if this adjustment occurs over a longer time frame. Thus it is likely that the introduction of a new public transport service – in Cape Town, in the form of an IRT starter service to be launched in 2011 – will have the effect of changing respondents' satisfaction with existing services from one time period to the next, even if there is no change in the quality of these services. In other words, the quality of services to which respondents are exposed, are likely to influence the quality of service they think is possible, and consequently adjust their expectations. If expectations are raised, what may have been deemed satisfactory before, will cease to be so. This suggests that longitudinal comparisons of repeated cross-section IPA data are likely to be unreliable as a measure of the impacts of public transport service improvements on passenger satisfaction levels – or at least that satisfaction is a moving target.

This proposition is supported by recent international data comparing the percentage of respondents who are satisfied with the public transport system in their city (US DoT 2010:15). These data support the notion that subjective customer ratings of dissatisfaction are not necessarily correlated to objective indicators of system performance. For instance, in Denmark around 53% of respondents indicated they were satisfied with public transport services in their area, compared to around 73% in Mexico. It is unlikely that objective measures of public transport system performance in poorly-resourced Mexico would outperform those in well-resourced Denmark to this extent, if at all. This suggests that 'predictive expectations' and 'comparative expectations', in particular, play a role in public transport satisfaction ratings.

6 CONCLUSION AND RECOMMENDATIONS

The aims of this paper were to explore improvements to conventional IPA in order to inform future waves of multi-modal passenger satisfaction measurement in Cape Town, and to explore the prospects for meaningful comparisons of repeated cross-section data.

With regard to improvements to the conventional quadrant IPA model, it is concluded that service attribute prioritisation insensitive to analytical technique. On the basis of the findings presented in this paper, the following are recommended for further passenger satisfaction measurement in Cape Town. Firstly, while not leading to significant changes in results, mean ratings are preferable to percentage ratings in plotting service attributes as they enable the views of all respondents to be reflected, and facilitate comparisons of weighted service category ratings across different public transport modes (as was undertaken in Behrens and Schalekamp 2010).Secondly, diagonal model plots are less arbitrary than quadrant model plots, as iso-priority runs diagonally across the plot area from most important and dissatisfactory to least important and dissatisfactory. Both techniques are nevertheless argued to include an element of arbitrariness. Thirdly, data-centred plots are preferable to scale-centred plots as the latter can theoretically yield large proportions of either prioritised or unprioritised attributes, and diagonal data-centred plots are more usefully based on 75thpercentile values so as to yield an effective prioritisation. Fourthly, given the potentially significantly different service attribute prioritisation rankings that can emerge from different methods of determining the slope of the diagonal model, it is recommended that both 45^{o} and best fit iso-priority line techniques are applied in analysis so that these differences are revealed – resulting perhaps in a categorisation of prioritised service attributes on the basis of those that appear in both plots, and those that appear in only one.

With regard to the prospects for longitudinal comparison of repeated cross-section data, it is concluded that changes in public transport service provision are likely to result in changes in passenger expectations and satisfaction. For repeated cross-section passenger satisfaction data comparisons to be meaningful, changes in expectations would need to be measured in surveys, and used to adjust satisfaction ratings. If such adjustments for longitudinal comparison cannot be undertaken reliably, then specific claims relating to the impact of system improvements on levels of passenger satisfaction cannot be made. Longitudinal comparison would no doubt remain useful for other policy purposes, but the above limitations would need to be explicitly acknowledged.

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Appendix A. Service attribute statements and ratings

Train passengers

Legend number	Descriptor	Service attribute statement	Mean dissatisfaction rating	Mean importance rating
1	seat availability	Trains always have seats available.	3.66	3.15
2	in-vehicle overcrowding	Trains are often overcrowded.	3.63	3.31
3	in-vehicle security personnel	There are enough security guards on trains.	3.47	3.60
4	graffiti	Trains are full of ugly graffiti.	3.62	2.26
5	seating density	Seats on trains are packed too close together.	3.08	2.72
6	open doors	Carriage doors are often open during journeys, and this makes you unsafe.	3.03	3.16
7	service transfers	I would not mind using more than one train to get to my destination.	3.13	2.80
8	station seating	There is enough seating at train stations.	2.99	2.99
9	service punctuality	Trains often arrive late.	3.08	3.50
10	seat comfort	Seats on trains are comfortable.	3.01	3.11
11	station weather protection	There is enough protection from the weather at train stations.	2.87	3.37
12	service frequency	The waiting gap between train services is too long.	2.96	3.17
13	station toilets	There are enough toilets at train stations.	3.05	2.88
14	vehicle reliability	You can be confident that trains will not break down or be involved in a crash.	2.62	3.64
15	station security personnel	There are enough security guards at train stations.	2.66	3.64
16	vehicle and station livery	Trains and train stations look nice.	2.92	2.72
17	passenger politeness	Passengers on trains are polite to one another.	2.90	2.58
18	in-vehicle staff customer care	Train conductors are helpful and friendly.	2.88	2.95
19	ticket purchase	You do not wait for too long to buy a ticket.	2.45	3.18
20	station staff customer care	The staff at train stations are friendly and helpful.	2.68	3.30
21	vehicle cleanliness	Trains are clean.	2.67	3.23
22	in-vehicle security	You feel safe amongst other passengers on the train.	2.61	3.56
23	boarding and alighting	It is easy to get on and off trains.	2.29	3.27
24	fare affordability	Train tickets do not cost too much.	2.25	3.33
25	travel speed	Trains travel too slowly and take too long to get to destinations.	2.55	3.14
26	in-vehicle temperatures	Temperatures in trains are not too hot or cold.	2.70	2.94
27	station cleanliness	Train stations are clean.	2.42	3.33
28	train bunching	Trains are often bunched together.	2.53	2.56
29	station passenger information	It is easy to find information on timetables and routes at train stations.	2.27	3.60
30	station security	You feel safe waiting at train stations.	2.37	3.58
31	in-vehicle reading	You can read a book on the train.	2.53	2.03
32	driver behaviour	Trains sometimes travel too fast.	2.39	2.87

Note: 1= highest satisfaction and lowest importance; 5= highest dissatisfaction and highest importance

Bus passengers

Legend number	Descriptor	Service attribute statement	Mean dissatisfaction rating	Mean importance rating
1	travel speed	Buses often travel slowly in traffic.	3.65	3.07
2	bus stop weather protection	There is enough protection from the weather at bus stops.	3.47	3.61
3	bus stop seating	There is enough seating at bus stops	3.44	3.43
4	seating density	Seats on buses are packed too close together.	3.41	3.22
5	service punctuality	Buses often arrive late.	3.37	3.58
6	service frequency	The waiting gap between bus services is too long.	3.42	3.31
7	driver behaviour	Bus drivers do not obey traffic laws, and sometimes drive too fast.	3.25	3.55
8	bus stop passenger information	It is easy to find information on timetables and routes at bus stops.	3.29	3.53
9	in-vehicle overcrowding	Buses are often overcrowded.	3.24	3.43
10	service transfers	I would not mind using more than one bus to get to my destination.	3.20	3.21
11	interchange weather protection	There is enough seating at bus interchanges.	3.12	3.50
12	seat availability	Buses always have seats available.	3.13	3.48
13	fare affordability	Bus tickets do not cost too much.	3.15	3.53
14	interchange security personnel	The staff at bus interchanges are friendly and helpful.	3.08	3.49
15	interchange seating	You feel safe waiting at bus interchanges.	2.90	3.45
16	bus bunching	Buses are often bunched together.	3.03	3.10
17	bus stop cleanliness	Bus stops are clean.	2.94	3.43
18	interchange toilets	There is enough protection from the weather at bus interchanges.	2.87	3.23
19	bus stop security	You feel safe waiting at bus stops.	2.68	3.63
20	in-vehicle temperatures	Temperatures in buses are not too hot or cold.	2.87	3.23
21	interchange staff customer care	There are enough toilets at bus interchanges.	2.74	3.43
22	vehicle reliability	You can be confident that the bus will not break down or be involved in a crash.	2.71	3.65
23	vehicle and stop livery	Buses, bus stops and bus interchanges look nice.	2.67	2.95
24	ticket purchase	You do not have to wait for too long to buy a ticket.	2.48	3.14
25	seat comfort	Seats on buses are comfortable.	2.52	3.44
26	interchange pax. information	It is easy to find information on timetables and routes at bus interchanges.	2.51	3.52
27	vehicle cleanliness	Buses are clean.	2.45	3.45
28	passenger politeness	Passengers on buses are polite to one another.	2.53	3.02
29	in-vehicle reading	You can read a book on the bus.	2.45	2.67
30	in-vehicle staff customer care	Bus drivers are friendly and helpful.	2.35	3.37
31	interchange cleanliness	Bus interchanges are clean.	2.35	3.33
32	interchange security	There are enough security guards at bus interchanges.	2.13	3.61
33	boarding and alighting	It is easy get on and off buses.	2.13	3.15
34	in-vehicle security	You feel safe amongst other passengers on the bus.	1.94	3.58

Note: 1= highest satisfaction and lowest importance; 5= highest dissatisfaction and highest importance

Minibus-taxi passengers

Legend number	Descriptor	Service attribute statement	Mean dissatisfaction rating	Mean importance rating
1	driver behaviour	Taxi drivers do not obey traffic laws, and sometimes drive too fast.	3.84	3.41
2	in-vehicle overcrowding	Taxis are often overcrowded.	3.72	3.17
3	vehicle reliability	You can be confident that the taxi will not break down or be involved in a crash.	3.65	3.52
4	ranking seating	There is enough seating at taxi ranks.	3.60	2.96
5	rank security personnel	There are enough security guards at taxi ranks.	3.58	3.41
6	seating density	Seats on taxis are packed too close together.	3.52	2.94
7	service transfers	I would not mind using more than one taxi to get to my destination.	3.41	2.97
8	in-vehicle music	Loud music in taxis is a problem.	3.57	2.79
9	rank cleanliness	Taxi ranks are clean.	3.52	3.27
10	rank toilets	There are enough toilets at taxi ranks.	3.62	2.95
11	seat comfort	Seats on taxis are comfortable.	3.44	3.13
12	in-vehicle waiting	You often wait too long in taxis before drivers leave.	3.41	2.84
13	fare affordability	Taxi fares do not cost too much.	3.24	3.26
14	vehicle and rank livery	Taxis and taxi ranks look nice.	3.47	2.84
15	rank weather protection	There is enough protection from the weather at taxi ranks.	3.30	3.12
16	taxi bunching	Taxis are often bunched together.	3.36	2.52
17	law compliance	Passengers are often inconvenienced by taxis being pulled over by traffic police.	3.30	3.05
18	journey time reliability	It is difficult to predict how long the taxi journey will take.	3.17	2.84
19	in-vehicle reading	You can read a book on the taxi.	3.35	2.32
20	rank staff customer care	The staff at taxi ranks are friendly and helpful.	3.31	3.04
21	rank security	You feel safe waiting at taxi ranks.	3.11	3.48
22	in-vehicle staff customer care	Taxi drivers and gaardjies are friendly and helpful.	3.28	2.92
23	rank passenger information	It is easy to find information on destinations and routes at taxi ranks.	2.93	3.16
24	cash-based fares	Carrying cash to pay for the taxi is not a problem.	2.85	2.88
25	vehicle cleanliness	Taxis are clean.	3.07	3.11
26	in-vehicle security	You feel safe amongst other passengers in the taxi.	2.87	3.31
27	in-vehicle temperatures	Temperatures in taxis are not too hot or cold.	3.00	2.58
28	service availability	You can always find a taxi when you need one.	2.57	3.34
29	travel speed	Taxis travel too slowly in traffic and take too long to get to destinations.	2.51	2.91
30	passenger politeness	Passengers on taxis are polite to one another.	3.02	2.43
31	boarding and alighting	It is easy to get on and off taxis.	2.63	2.83

Note: 1= highest satisfaction and lowest importance; 5= highest dissatisfaction and highest importance