SEGMENTATION ANALYSIS OF USERS' PREFERENCES TOWARDS BUS SERVICE QUALITY

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Abstract

Increasing passenger patronage through a behavioural shift from car-based transport is a key policy objective. A review of the literature indicates that users' preferences towards the quality of public transport vary significantly amongst different categories of users. Therefore, it is essential to identify and meet the quality demands of different categories of users. Public transport should provide the level of quality demanded by current users, and importantly, the level of quality desired by potential users. This paper presents evidence on the measurement of users' preferences towards bus service quality, and the development of segmentation analysis of users' preferences based on both socio-economic and travel behaviour characteristics. The paper draws upon the data from 512 questionnaires. Firstly, users' preferences are derived using Analytical Hierarchy Process (AHP) application for a set of 29 bus quality indicators classified into six main attributes. Secondly, five pairs of AHP models are developed to measure the preferences of five segments including gender, income, place of living, occupation, and travel mode. In addition, the level of variations within each segment is measured to identify the internal composition of the preferences held by each segment. The implementation of this paper provides a powerful tool to understand the salient preferences of each segment, and offers policy makers with clear indication for the development of market-oriented policy packages that consider the differential demands/desires of users.

1. Introduction

It is widely recognised that the perspective of the UK transport political agenda has been shifted from service provision towards improving the quality management process in order to alleviate the problems resulting from the accelerated car dependency. This political shift has imposed several demands to achieve sustainable and integrated transport solutions in order to attract more people to public transport. Accordingly, it is recognised that public transport should be able to accommodate the quality level demanded by current users, and most importantly, the quality level desired by potential users [1, 2].

A review of public transport quality literature highlights several attempts to address the service quality that involve the analysis of travel behaviour [3], behavioural intentions [4, 5], mode choice [1], performance quality [6], perception, perceived quality, and desired quality [2, 7, 8]. These attempts have indicated that the behaviour intentions of users, and therefore mode choice, are influenced by the quality of the service and the preferences of individuals towards different attributes of the service. It is concluded that different categories of users evaluate the quality of the service in different patterns, and therefore, they must be targeted with different approaches/policies [2, 3]. Within the massive shift in public transport market structure, from regulation to competition, there is an essential need to develop market-oriented quality schemes that can accommodate the differential needs of users [9]. This can be achieved by identifying homogenous groups of users (current and potential) who share similar preferences towards the quality of the service, and therefore, their demands/desires could be targeted in the same manner [2, 3, 10].

The aim of this paper is to measure the preferences of different categories of users towards the quality of bus service, and to determine the salient preferences of different segments in the market. These segments include socio-economic, travel behaviour, and location segments. The paper is organised as follows: section 2 reviews the international literature of bus quality and draws upon two aspects including users' preferences and market segmentation. Section 3 outlines the utilisation of the Analytical Hierarchy Process (AHP) method for measuring users' preferences and illustrates the data collection/analysis

procedures. Section 4 reports the empirical results and profiles the preferences of different segment. Lastly, the implementations of the findings are discussed in section 5.

2. Literature review

2.1. Preferences towards bus quality

Since the inception of public transit quality loop in the 1990's, two distinct measures of quality have been operationalised in the literature; namely performance-based quality measures and perception-based quality measures [11]. The former focuses on evaluating bus performance quality from service providers' perspectives in terms of productivity, effectiveness, and efficiency. While the later focuses on measuring the quality of bus service form users' perspectives to identify different patterns of quality based on the perceptions of different categories of users.

The analysis of the interrelationships between these two measures has clearly distinguished that the performance quality of the service should fulfil the quality level demanded and desired form users [12, 13]. Accordingly, attempts have been made to operationalise perception-based quality measures in different forms. These include the measurements of attitude, perception, satisfaction, and preferences. The main rational is to identify the multidimensional dynamic relationships between the performance quality of the service and the behavioural intentions and mode choice of users [1, 2]. Therefore, the identification of users' preferences towards different attributes of bus service represents an essential aspect to examine how different categories of users are influenced and/or motivated with different attributes. In this respect, preference has been defined as the level of importance regarded to different attributes of the service [2, 7].

Several attempts (qualitatively and quantitatively) have been carried out to measure the preferences of users towards bus service. Reference [1] has investigated the attitudes of bus and car users towards different travel modes, and it has concluded that travel time, reliability, comfort, safety, and information are regarded as the key preferences that influence the perceptions of both current and potential users. Reference [7] has indicated that five main attributes represent the most important attributes of the service including safety, scenery, flexibility, freedom, and cost. While, reference [13] has argued that reliability, frequency, availability of stops, and cost represent users` preferences towards bus service. Furthermore, reference [2] has highlighted that waiting time, journey time, and comfort represent the attributes of significant importance to users. This review clearly shows that the preferences of users vary significantly within several factors (e.g. context, time, and user characteristics). Therefore, it is imperative for policy makers and operators to distinguish the preferences of homogenous groups of people in order to develop specific policy packages that consider the differential needs of each group [3, 9].

The methods of measuring users' preferences towards bus service quality are mainly operationalised (quantitatively) through three approaches including stated, derived, and integrated [11]. In the stated approach, preferences are measures as stated values expressed by users in a ranking scale (e.g. Likert scale). While, in the derived approach, preferences are derived from the degree of statistical association between cumulative and disaggregated measures (e.g. multiple regression analysis). In contrast, the integrated approach relies on a multi-criteria analysis of users' preferences through a series of pairwise comparisons between attributes (e.g. Analytical Hierarchy Process). Although both stated and derived approaches are the most prevalent in the literature, they have been criticised for several aspects. It has been argued that users cannot explicitly express their preferences towards the service quality, and therefore, the results generated from direct weight election in the stated approach may lead to limited results [2, 11]. While the multicollinearity between attributes, even if it reduced by factorial design, adds several constraints for evaluating users' preferences towards the service quality in the derived approach [11].

2.2. Market segmentation

The concept of market segmentation has been frequently advocated by service providers in order to align marketing strategies with the deferential needs of customers [3, 9], and to develop market-oriented policies that could be readily implemented across the sector. The term segmentation has been defined as "*the act of defining meaningful sub-groups of individuals or objects*" [3], pp-66. The main rational of market segmentation is to reduce the number of individuals dealt with into a manageable number of groups that share the same characteristics [14], and therefore, there demand/desires could be targeted with similar strategies [9, 15].

Transport market segmentation has been operationalised using different approaches. These

approaches are categorised into the priori approach and post hoc approach [10]. In the priori approach, segments are defined in advance based on known characteristics, and then, the perceptions/behaviours of each segment are analysed. While, the post hoc approach relies on a multivariate analysis of several combinations of variables to define the salient segments in the population, and therefore, the segments are identified by the similarity of individuals' attitudes towards these variables. Although each approach utilises different concept of market segmentation, they are not discrete as they first appear, instead, they represent different end on a continuum [3, 9, 10].

The literature highlights the applications of both priori and post hoc approaches for bus market segmentation. Reference [10] has provided extensive review for implementing different segmentation approaches to increase transit ridership. Reference [15] has utilised interview data, and has identified six segments of mobility that include three car-driving segments and three public transit segments. While, reference [3] has applied post hoc segmentation analysis using attitudinal and psychographic data to identify different segment of travel behaviour and mode choice. Furthermore, reference [9] has applied a combination of priori and post hoc to identify segments of air line customers.

However, this paper differs from the current literature in that it measures the preferences of different segments towards the quality of bus service. Therefore, the focus of the paper is more oriented towards measuring the preferences of different categories of users, and identifying the level of variation on the preferences within each segment in the market. As a result, the paper utilises the priori segmentation approach to measure the preferences of five main segments namely gender, income, place of living, income, and user statues (current and/or potential). The paper argues that measuring the preferences of different segments of the market, and the level of variation within each segment is essential for developing market-oriented policies and for rationalising resource allocation.

3. Methods

The method of measuring users' preferences towards bus service quality utilises the applications of the Analytical Hierarchy Process (AHP). Since its inception over 30 years ago by Saaty, the AHP method has been used as a powerful tool to solve a wide range of multi-criteria decision problems. The creativity of the AHP method is attributed to its ability to solve multidimensional problems through pairwise comparisons that identify the relative importance between sets of criteria or sub-criteria. The main different between AHP and other MCDM methods is that AHP has introduced a combination of multilayer and multidimensional approaches for problem solving [16, 17, 18, 19]. In addition, AHP has linked the qualitative and quantitative methods through a combination of both objective and subjective assessments in a simple and logical form. In practice, the applications of AHP method vary from solving simple decision-making problems to complex multi-discipline problems [20]. Therefore, AHP has been implemented in many disciplines including the industry, military, business, social sciences, transport, and policy [21].

In the transport context, AHP method has been operationalised for several objectives including the selection between corridors and network structure [22], and the analysis of attitudes and perceptions towards service quality [23]. It has been also used for measuring attitudes towards sustainable transport [24], risk analysis, and traffic management [25]. The AHP method has provided the required depth and breadth in understanding the multidimensionality of transport systems, and it is recognised as an important element of the transport research context.

In general, the AHP method is carried out in two stages including AHP hierarchy structure and Eigenvalue Method (EM) of weight election [19, 26, 27]. The apex of the AHP hierarchy represents the aim of the decision under investigation. While, the second level represents a set of multiple objectives (often expressed as criteria) that address the multidimensionality of the overall aim. Lastly, sets of sub-criteria and alternatives are classified in the lower levels of the hierarchy. The AHP hierarchy indicates the relationships between variables and elements in the same horizontal level/layer and the vertical relationships within each column, [19, 20, 24, 26] and therefore, it accommodates both dynamic and detailed complexities associated with measuring users' preferences towards bus quality [24].

A set of 29 quality indicators, derived from literature review and focus group discussions, has been utilised in the AHP hierarchy as illustrated in Table 1. These indicators are classified into six main attributes that represent the multidimensionality of bus quality and include service design, access to service, operation, information & facility, fares, and safety & security. The preferences of users towards the quality of bus service are derived using the standard AHP pairwise comparison scale.

Table 1, Bus main attributes and quality indicators

Main Attributes	code	Indicators	Code
Service Design	SD	- The comfort, cleanliness, and crowding of the bus	SD_COB
		- Need for transfers	SD_NFT
		- Driver attitude & helpfulness	SD_DAH
		- Route (Network area covered)	SD_NAC
Access to service	AS	- Ease of access stops (routes & infrastructure)	AS_EAS
		- Bus stop location and distance between stops	AS_BSL
		- Handicap access installations	AS_HAI
		- External interface to pedestrians, cyclists, car & taxi	AS_EIP
		- Availability of park and ride schemes	AS_APR
Operation	OP	- Waiting & transfer time	OI_WTT
		- Boarding & Alighting time	OI_BAT
		- Total travel time	OI_TTT
		- Reliability of the service (arrival time)	OI_ROS
		- Operating hours	OI_SOH
		- Frequency (Weekly, weekend, and holidays)	OI_FOS
Information & Facilities	IF	- Availability of shelters, benches and waiting areas at stop	IF_ABW
		- Availability of amenities (Enquiries points, sanitary, refreshment) at terminals	IF_AVA
		- Information during travel (Real time information)	IF_IDT
		- Availability of information at station (signs, schedule and maps)	IF_IAS
		- Pre–trip information (phone & web)	IF_PTI
Fare	FA	- Bus fare	FA_BFA
		- Availability of multiple-mode tickets	FA_AMP
		- Ease of purchasing tickets (on board, at stops, at terminals)	FA_EPT
		- Availability of monthly discount passes	FA_AMD
Safety & Security	SS	- Visible monitoring (CCTV)	SS_CTV
		- Lighting, noise, vibration, speed, and temperature on bus	SS_LNV
		- Safety during trip (Day & night)	SS_SDT
		- Absence of offensive	SS_AOO
		- Security against crimes on bus & at stops	SS_SAC

In addition, a Multivariate Analysis of Variance (MANOVA) is carried out to detect the level of variation in the preferences of each segment. MANOVA is a powerful tool that used to detect group differences on a set of several dependant variables [14]. MANOVA offers fundamental setting that controls the inflated *type I & II errors* generated by running separate models of the analysis of variance (ANOVA). Although MANOVA is a robust analysis that offers many advantages, these advantages come with a cost. Several statistical assumptions are compulsory for validating the MANOVA models. Therefore, series of pre-tests, including normality, outliers, linearity, and homogeneity, are carried out before the analysis [14]. However, the results of these pre-tests indicate that the data meets the required assumptions for both Univariate and Multivariate analysis.

3.1. Sampling and data collection

The data of users' preferences towards bus quality is collected using a questionnaire survey distributed across Belfast City, UK. The sample is stratified to ensure firstly, the balance between participants in each segment, and secondly, the diversity of the socio-economic variables. Moreover, the diversity of geographical location (rural and urban) is taken into consideration to ensure that different constraints and opportunities are accounted. Three surveying approaches have been utilised for the data collection including household, online, and intercept at main bus terminals. Each participant is provided with a questionnaire survey and an information package.

For sampling size, reference [27] has indicated that at least 15 cases are required for the AHP data analysis. While, reference [24] has argued that the principles of the convenience sampling strategy (5* number of indicators) should be implemented for AHP data. However, since the data analysis utilises both AHP and MANOVA, the sample size is calculated to meet the required standards for the multivariate data analysis as follows:

$$n = \frac{t^2 * p * q}{d^2} = \frac{1.95^2 * 0.5 * 0.5}{0.05^2} = 384 \qquad \text{Eq, (1) [28]}$$

Where, n= acceptable sample size, t = corresponding value for alpha level, p= proportion of the population, q = (1-p), and d = sampling error.

However, almost 1000 questionnaires are distributed, and 512 complete and valid questionnaires are used in the analysis.

4. Results

The results of the AHP overall model have identified users` preferences towards bus quality for both main attributes and indicators levels. Firstly, the results of the main attributes indicate that safety & security (SS= 0.2339) has been perceived with relatively higher importance followed by fares (FA= 0.1952) and operational (OP= 0.1900) attributes. The results also indicate that service design (SD= 0.1084) has been perceived with relatively less importance. On the other hand, the results of indicators level indicate that six indicators have been regarded with relatively higher importance. These indicators include security against

crime (SS_SAC= 0.083), availability of multi mode tickets (FA_AMP=0.074), bus fare (FA_BFA= 0.069), frequency of service (OI_FOS= 0.061), reliability of service (OI_ROS= 0.053), and bus stop location (AS_BSL= 0.048). While, three indicators have the lowest preference scores including availability of amenities (IF_AVA= 0.008), boarding and alighting time (OP_BAT= 0.006), and information during travel (IF_IDT= 0.014) as detailed in Table 2.

Table 2, AHP modelling of users` preferences

Attributes/ Indicators	Codes	Attribute weight	Indicator Local Weight	Indicator Global Weight (Attribute W * Indicator W)
Service Design	**SD**	**0.1084**		
- Comfort of bus	SD_COB		0.3311	0.0359
- Need for transfer	SD_NFT		0.3094	0.0335
- Driver attitude	SD_DAH		0.1361	0.0147
- Network area coverage	SD_NAC		0.2234	0.0242
Access to service	**AS**	**0.1581**		
- Ease of access	AS_EAS		0.2285	0.0361
- Bus stop location	AS_BSL		0.3042	0.0481
- Handicap access	AS_HAI		0.1031	0.0163
- External interfaces	AS_EIP		0.0853	0.0135
- Park & ride schemes	AS_APR		0.2788	0.0441
Operation	**OI**	**0.1900**		
- Waiting & transfer time	OI_WTT		0.1784	0.0339
- Boarding & alighting time	OI_BAT		0.0341	0.0065
- Total travel time	OI_TTT		0.0837	0.0159
- Reliability of service	OI_ROS		0.2798	0.0532
- Operation hours	OI_SOH		0.1030	0.0196
- Frequency of service	OI_FOS		0.3210	0.0610
Information & facilities	**IF**	**0.1145**		
- Waiting areas	IF_ABW		0.3517	0.0403
- Availability of amenities	IF_AVA		0.0677	0.0078
- Information during travel	IF_IDT		0.1223	0.0140
- Information at stop	IF_IAS		0.2634	0.0302
- Pre-trip information	IF_PTI		0.1948	0.0223
Fares	**FA**	**0.1952**		
- Bus fares	FA_BFA		0.3530	0.0689
- Multi-operators tickets	FA_AMP		0.3816	0.0745
- Ease of purchasing	FA_EPT		0.1737	0.0339
- Discounted tickets	FA_AMD		0.0916	0.0179
Safety & security	**SS**	**0.2339**		
- CCTV monitoring	SS_CTV		0.1394	0.0326
- Lighting, noise, vibration	SS_LNV		0.1322	0.0309
- Safety during travel	SS_SDT		0.2282	0.0534
- Absence of offensives	SS_AOO		0.1443	0.0338
- Safety at stops/stations	SS_SAC		0.3559	0.0832

Several indications are derived from the AHP model. Firstly, although the results show that users have placed higher importance to safety & security, operation, and fares attributes, there is no single attribute dominating the preferences of users towards bus quality. Secondly, the weights of the 29 quality indicators show that 10 indicators represent 56.1% of users` preferences and these 10 indicators are distributed amongst different attributes. These indicators include security against crime (SS_SAC= 0.083), availability of multi–operators tickets (FA_AMP= 0.074), bus fare (FA_BFA= 0.069), service frequency (OP_FOS= 0.060), reliability of the service (OP_ROS= 0.053), security during travel (SS_SDT= 0.053), bus stop location (SD_BSL= 0.048), availability of park & ride schemes (AS_APR= 0.044), availability of waiting area (IF_ABW= 0.040), and comfort of bus (SD_COB= 0.036). Although few previous attempts have investigated the preferences of users towards a wide range of indicators [12, 29], the results of the AHP modelling are consistence with the current literature [2, 7, 12, 30]. However, it should be pointed out that the sensitivity of Belfast context is clearly reflected on the findings with higher importance regarded towards safety & security attributes.

Five segments are defined to measure the preferences of different categories of users including gender, occupation, income, place of living, and user status. Each segment is defined with two dummy variables. As a result, five pairs of AHP-preference models are developed, illustrated, and analysed.

In the first segment (gender), the results indicate that both males and females share the same preference pattern towards bus service with higher importance assigned to safety & security, fares, and operational attributes, but they don`t share the same values assigned to each attribute and/or indicators. Females (n= 272) have placed relatively higher importance – than males – for indicators associated with information & facilities (IF= 0.1227) and access to service (AS= 0.163) attributes, while males (n= 240) have considered indicators related to service design (SD= 0.128) and fares (FA= 0.202) with higher importance. For indicator level, the results indicate that both males and females share the same pattern of preferences towards quality indicators as detailed in Figure 1.

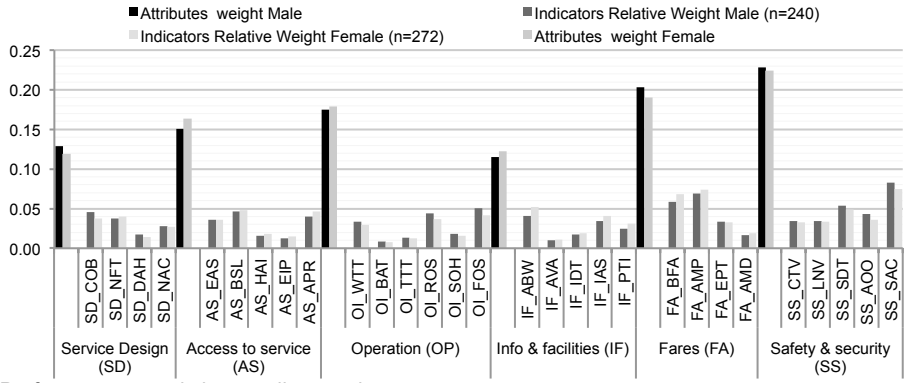

Figure 1, Preferences towards bus quality; gender segment

In the second segment (occupation), the results show that both employed and unemployed categories share the same pattern of preference. However, unemployed (n= 215) have assigned relatively higher importance for indicators related to access to service (AS= 0.131) and information & facilities (IF= 0.163), while employed (n= 297) have assigned higher importance towards indicators associated with safety & security (SS= 0.233) and operational (OP= 0.180) attributes as detailed in Figure 2.

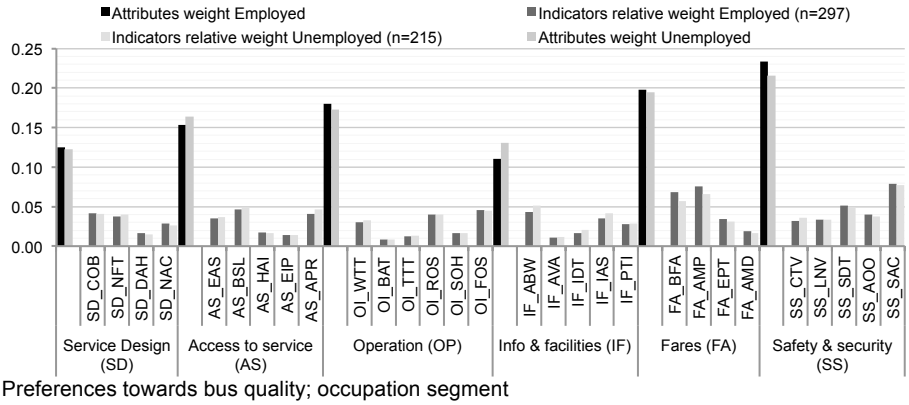

Figure 2, Preferences towards bus quality; occupation segment

The results of the third segment (place of living) show that although both categories share the same preference pattern towards main attributes, they have different pattern of preference towards indicators. People living in rural & periphery areas (n= 289) have assigned higher importance to indicators related to access to service (AS= 0.162) and information & facilities (IF= 0.124). While, people living in city centre & urban areas (n= 233) have placed higher importance to indicators associated with safety & security (SS= 0.230) and operational (OP= 0.179) attributes as detailed in Figure 3.

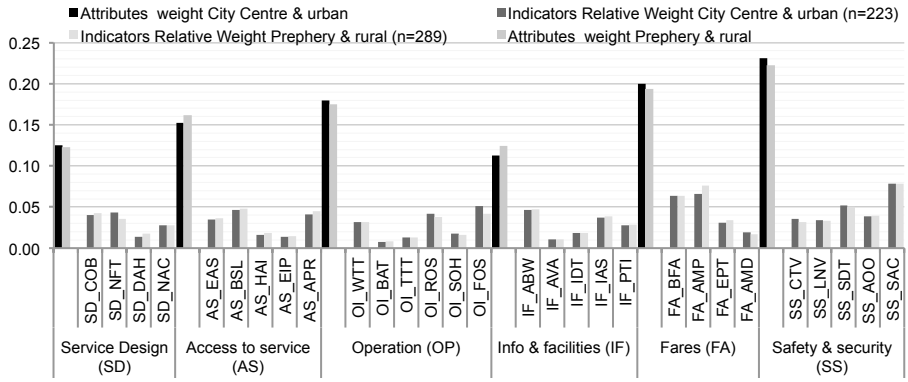

Figure 3, Preferences towards bus quality; place of living segment

The results of the fourth segment (income) show that both low and high-income categories don`t share the same preference pattern towards bus service. High-income category (n= 126) has assigned higher importance for both safety & security (SS= 0.245) and operational (OP= 0.207) attributes, while low-income category (n= 386) has assigned higher importance for safety & security (SS= 0.220) and fares (FA= 0.200) attributes. This variation on the preferences of each group towards main attributes was clearly reflected on the indicators level as detailed in Figure 4.

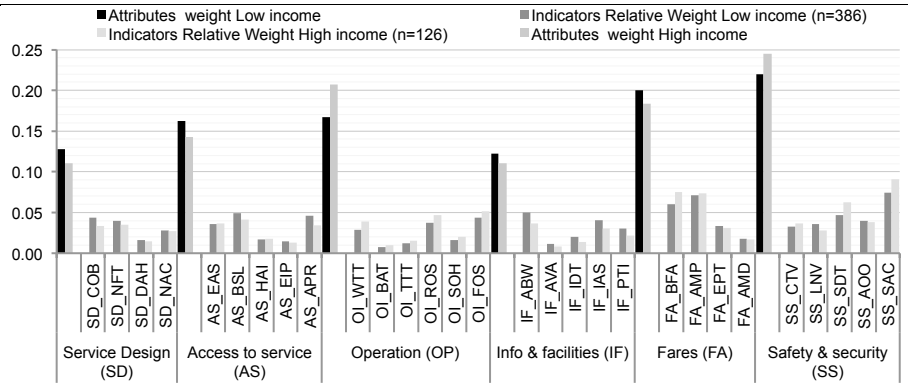

Figure 4, Preferences towards bus quality; income segment

Lastly, the results of the fifth segment (user status) indicate the both current and potential users share the same preference pattern towards main attributes only. Potential users (n= 270) have assigned higher importance to indicators related to access to service (AS= 0.203) and operational (OP= 0.191) attributes, while, current users (n= 242) have assigned higher importance to indicators related to safety & security (SS= 0.242) and service design (SD= 0.120) attribute as detailed in Figure 5.

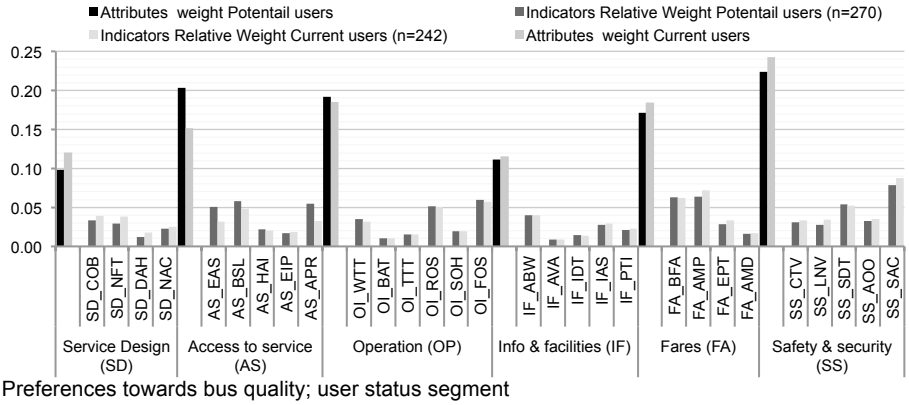

Figure 5, Preferences towards bus quality; user status segment

A multivariate analysis of variance[1] is carried out to investigate the extent of the variation in the preferences held within each segment. The results of the first two segments (gender & occupation) show no significant variation amongst the participants of each segment. While, the results of the third segment (place of living) indicate the existence of significant variation on the preferences of each category towards main attributes (access to service, and information & facility), but without major impact over indicator level.

In contrast, the variation analysis indicates the existence of significant variation on the preferences of both low and high-income categories (fourth segment) towards both attributes and indicators levels. For attributes level, the results indicate significant variation on the preferences towards access to service and operational attributes. While, for indicators level 10 indicators have a statistically significant variation including comfort of bus (SD_COB), bus stop location (AS_BSL), availability of park and ride (AS_APR), waiting time (OP_WTT), bus fare (FA_BFA), information at station (FF_IAS), frequency of service (OP_FOS), reliability of service (OP_ROS), and security during travel (SS_SDT).

In addition, the results of the fifth segment (user status) indicate that although both categories share the same pattern of preferences, they have significant variation on their preferences towards numerous indicators. These indicators include availability of multiple–mode tickets (FA_AMP), ease of purchasing tickets (FA_EPT), availability of monthly discount passes (FA_AMD), ease of access stops (AS_EAS), availability of park and ride schemes (AS_APR), lighting, noise, vibration, speed, and temperature on bus (SS_LNV), and security against crimes on bus & at stops (SS_SAC).

The segmentation modelling has provided in-depth analysis of the preferences of each segment. It highlights the absence of significant variation on the preferences of many segments including gender, and occupation. While, the findings of the last three segments

[1] Due to space limitation, all Tables for the MANOVA results are not included in the paper. However, the results are available upon request form the authors.

(place of living, income, and user status) have provided clear evidence that the internal composition of each segment should be treated separately regarding their preferences towards bus service quality for developing market-oriented policies.

5. Conclusion

The findings of the paper support the theoretical arguments that different categories of users have different preferences towards bus service [31], and emphasise on the essential need to analyse the differential needs of each category if we are to increase bus transit ridership. The overall modelling of users' preferences highlights the importance of both safety & security and operational attributes, and indicates that 10 indicators have the lion's share of users` preferences towards bus quality. In addition, the segmentation analysis of users' preferences indicates the existence of significant variation on the preferences held by different segments of users, and within each segment. However, the findings show that several segments share the same preference pattern towards bus quality, even if they have significant variation in the values regarded to each attribute/indicator, except for two segments namely users' statues and income. Therefore, the paper concludes that although market segmentation is essential for developing policies that can accommodate the demands/desires of different categories of users, the internal composition of each segment should be considered in the process. Therefore, the combination of both priori and post hoc segmentation approaches is essential for better understanding of the market structure.

6. References

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