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# Public bus transport service satisfaction: Understanding its value to urban passengers towards improved uptake

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**ABSTRACT:** To accurately direct investments towards sustainable transit, current transport status and factors driving passengers towards private cars instead of public transport (PT) should be identified first. Past research advocated improvements in PT to shift mode-usage *but* has yet to model the different causal effects that direct bus users to cars in rapidly developing yet congested areas. On-board questionnaire survey data from intra-city Abu Dhabi bus passengers (*n = 1520*, *variables = 31*) over a month were gathered in this study during both weekends and weekdays. The study modelled existing bias of travellers *and* quality attributes as antecedents of bus service's perceived *value for money* (VfM) and *satisfaction from level of service* (LoS) and mode choice (car vs. bus) as the ultimate consequence. Findings revealed that any previous biased opinions of travellers adversely affected satisfaction and perceived value, while quality attributes had a positive effect. Mode use was influenced by satisfaction from LoS (frequency of buses and network coverage), which was a positive consequence of perceived VfM (quality of ride and level of fare trade-off). Journey time and bus-stop waiting area quality also positively influenced satisfaction from fare level while passenger socio-demographic distribution showed that most respondents travelled more than five times a week by bus and were full-time workers and transport agencies may target service improvements around office-hours.

## 1. INTRODUCTION

Individual travel *mode use over time* affects personal well-being of travellers and sustainability performance of roads (Hasan, Whyte, & Al Jassmi, 2019), particularly in case of overreliance on cars. Cities around the world and specifically in developing countries heavily rely on public bus services to decrease public dependence on private automobile usage. Transport agencies constantly develop strategies to maintain public transit as a more sustainable (Kwan, Sutan, & Hashim, 2018) service. These strategies include increasing service frequency and accessibility (Renne, Hamidi, & Ewing, 2016), reducing journey time on buses and priority lanes (Wu & Pojani, 2016), discounting bus fares, improving bus-stop quality. These imperatives are often based on sound transportation research such as theory of planned behaviour, degree of circuity, attitude theory and consumer behaviour theories. These studies and initiatives provide viable initial steps, however the causal effect of these attributes towards passengers' perception of public transport (PT) service and their mode choices, remains uncertain. Furthermore, there has been little research on prioritising policy decisions sensitive to practical issues.

This paper provides a model for analysing transit data, collected for indicating the underlying roles played by these factors towards mode use. This study analyses passenger behaviour along the same lines by attempting to investigate the relation between their satisfaction from level of service and the subsequent mode use. The effects of user satisfaction from PT level of service (LoS) and its status as a product that provides some value for money (VfM), are modelled in this study against mode choices. Past research shows that public transit (e.g., bus) mitigate public reliance on private vehicles. However, the mode choices of passengers are increasingly becoming more complex as their understanding of ride quality, network coverage, and service affordability, etc., is changing (Hasan, Whyte, & Al Jassmi, 2020). These factors constrain passenger willingness to choose PT over private vehicles as it increases traveller likeness (dell'Olio, Ibeas, & Cecin, 2011) towards private cars and prejudice against public transit (hereby referred to as *travel bias*).

Mugion et al. (2018) modelled PT quality attributes of journey time, on-board crowding and accessibility as predictors of passenger satisfaction. Other researchers (Chaloux, Boisjoly, Grisé, El-Geneidy, & Levinson, 2019; Echaniz, dell'Olio, & Ibeas, 2018) tested hypotheses based on transit theories that travel bias affect perceived quality and satisfaction level from PT. Abou-Zeid and Fujii (2016) noted that passengers favoured private cars over PT if they perceive the latter fails to meet their expectations and as such, satisfaction from LoS can be conceptualised as a composite variable inclusive of both factors. Although these studies have identified the impact of perceived quality and travel bias on passenger satisfaction and perception, there are some gaps in transport research. The concept of a transport service's value to passengers has been studied in travel behaviour research (Hasan, Whyte, & Al Jassmi, 2018a). Yet, there is little empirical research as to what these service consumers perceive as "value" and how it may influence their overall satisfaction. Moreover, many antecedents of mode choice and satisfaction are given in the literature, e.g., journey time (Chaloux et al., 2019), network coverage (Fu, Zhang, & Chan, 2018), ride quality (Sam, Hamidu, & Daniels, 2018), fare level (Kamaruddin, Osman, & Pei,

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2017), bus-stop distribution and service frequency (Echaniz et al., 2018). But these are usually individually analysed in travel research and relationships between these variables are not investigated using concise models.

This paper contributes to the literature by developing a model that can identify the important variables (from travel data) influencing the satisfaction level and mode choice of travellers for any studied location. Once the exact effect of important variables is validated, optimisation (and in-depth analysis) can then be performed in the subsequent stage (transit project proposal evaluation studies) towards PT uptake. The goal is to test assorted hypotheses from transport research (based on transit theories) that passenger biases, perceived service quality and value affect satisfaction level, which then affects mode choices. Travel survey data from a case study region (Abu Dhabi city) is utilised to indicate the roles played by passenger satisfaction and perceived (bus service) value towards PT usage. Since, such users are already familiar with the LoS, reliability and routes, they may provide more informed responses (Mouwen, 2015).

The remainder of this paper is organised as follows. Literature review discusses the theoretical background and gaps in existing research. Research hypotheses based on mode choice, satisfaction, quality and passenger perception literature are then presented. Next, case study area, travel survey data collection and analysis technique are discussed. Structural equation modelling (SEM) is used in this study for testing the hypotheses because of the following reasons. It is largely advocated in transport literature (Hadiuzzman, Das, Hasnat, Hossain, & Rafee Musabbir, 2017) to model the relation between passenger psychologies, satisfaction, mode choices and transport quality attributes. Additionally, transport literature (van Lierop & El-Geneidy, 2016) shows passenger biases, satisfaction, service perception and mode choices to have complex relationships where these variables affect each other. SEM allows modelling of any variable as both dependent and independent variable (Guirao, García-Pastor, & López-Lambas, 2016) unlike other approaches (e.g., multiple-regression, multinomial models, bivariate correlations, etc.), like the real-world relationships between these variables.

## 2. LITERATURE REVIEW

Increased dependence on private vehicle usage produces congestion on intra-city roadways. Cities around the world and specifically in developing countries heavily rely on public bus services to decrease public dependence on private automobile usage (Hasan et al., 2018a). a shift from PT to private cars is a common issue as the purchase of cars becomes more affordable due to low production costs and competitive car financing schemes, which renders private cars more accessible. The attitude of people towards transportation systems is also increasingly becoming more complex as their understanding of ride quality, network coverage, and fare level, journey purpose, travel duration and service frequency is changing (Renne et al., 2016).

For the PT operating agencies to gain a competitive advantage over private automobiles, transportation decision-makers need to understand the attributes valued most by passengers so that their attention can be focused on those critical attributes. Transport researchers (Hadiuzzman et al., 2017) are now focusing on establishing the relationship between passenger characteristics and biases, service affordability, perceived quality and satisfaction level. Kamaruddin et al. (2017) used structural equation modelling (SEM) and descriptive statistics to show passenger loyalty and satisfaction levels as the attributes that cause them to prefer a particular mode of transport. Liu, Sheng, Mundorf, Redding, and Ye (2017) incorporated theory of planned behaviour (TPB) to predict passengers' intention to reduce private vehicle usage. Their results showed that passenger biases, habits, behavioural characteristics, and perception affected mode choice of passengers. Another study by Yuda Bakti et al. (2020) evaluated passengers' perception of PT service as value for money. They explored passengers' willingness to recommend PT as a measure of passengers' perception of the service by combining personal norm, customer satisfaction and planner behaviour theories. Their results also found that passenger biases and behavioural characteristics affected passengers' perception of PT.

Shen, Xiao, and Wang (2016) analysed satisfaction from LoS as a function of quality perceived by the passengers and their expectations and travel biases towards different travel modes. Echaniz et al. (2018) point out that even though passenger satisfaction is a dependent variable (affected by aforementioned variables), it can be used to predict passengers' mode choice pattern. Kroesen, Handy, and Chorus (2017) suggested that improved ride quality, low level of fares and better service on part of the policymakers may entice more travellers towards PT. It should be noted at this stage that improving ride quality does not necessarily imply oversupply of service (Abenoza, Cats, & Susilo, 2017; Friman & Fellesson, 2009), rather implies that travellers are perhaps seeking value for money in the service for customer attraction and client retention.

Heinen and Chatterjee (2015) propose that passenger psychologies due to age, social status, access to car and PT, etc., somewhat limits mode choice by influencing their satisfaction from the service. These passenger psychological variables are essentially a three-dimensional problem; spatial (e.g., journey purpose and accessibility), structural (e.g., financial and work commitments) and socio-demographic constraints (e.g., age, gender, and social status). It can be summarised that this three-dimensional travel bias of passengers towards transit mode influence satisfaction from the LoS. Research into passengers' travel bias showed that quality attributes (journey and waiting time, distance to bus-stop and travel comfort, etc.,) significantly influence passenger perception. Guirao et al. (2016) proposed that the socio-demographic constraints of travellers also affect their respective rankings of quality attributes. Lavery, Páez, and Kanaroglou (2013) found that respondents expressed PT of higher value provided journey time is optimised. Shen et al. (2016) found passengers' perceived VfM of service is positively affected by their ranking of service quality attributes. These studies imply that the bias held by passengers affects their perceived ranking of quality attributes while both factors influence the perceived VfM of the transport service. Two studies (Abou-Zeid & Fujii, 2016; Mugion et al., 2018) found that the satisfaction level of passengers from PT indirectly stems from their perception of the transit service quality.

Moreover, most of these studies found quality attributes of journey time and ease of travel as the most significant indicators of satisfaction from LoS followed by distribution and quality of bus-stops, cost, and on-board crowding and seating. Kamaruddin et al. (2017) found passenger satisfaction as an antecedent of mode use choices. They further suggested the importance of improved ride quality, low level of fares and better service towards improved PT uptake. However, Lovelock and Wirtz (2016) describe the perceived VfM as some sort of a middle ground between perceived cost and benefits. Interestingly, few studies in transportation literature (e.g., Shen et al. (2016)) empirically investigated this relationship. It should be noted that improving ride quality does not necessarily imply oversupply of service, rather implies that travellers are perhaps seeking value for their money. The current study models perceived VfM as a trade-off between ride quality satisfaction and level of fare to study the effect on the satisfaction from LoS. An early qualitative study (Beirão & Cabral, 2007) found that mode choice is affected by exogenous variables of latent "satisfaction from LoS" variable: quality attributes, traveller bias and user characteristics. van Lierop and El-Geneidy (2016) used SEM to find that passenger satisfaction from PT is positively related to its preference as travel mode by Canadian passengers. This further implies the role of affective elements (Abenoza et al., 2017; Guirao et al., 2016) such as level of fare, journey time and purpose, network coverage and service frequency, etc., in determining the mode choice of transit users.

The transit studies reviewed above acknowledge that trave bias, perceived quality and value of PT services affect the satisfaction level and mode choices, with less emphasis on the interlinked relationship between all variables. Transit research still lacks a general research model capable of understanding interconnection between several variables of service quality, value and satisfaction that promote mode choices towards PT uptake. The real-world complex relationships between these travel survey variables are both dependent and independent, and research model and hypotheses should be aimed to fill the literature gap by modelling this relationship.

## 3. PROPOSED RESEARCH MODEL AND HYPOTHESES

Based on the above literature, the research model proposed by this study (Figure 1) explores the interlink between travel bias, perceived quality, VfM, satisfaction from LoS and mode choice variables; to understand the critical variables that can promote PT use. This research model argues that if passengers are treated as consumers and public transit systems (e.g., a bus service) as a marketable product, understanding their motivations may help increase "sale" of the supplied "product". To that end, passenger behaviour is analysed by developing a multipartite model. The effects of user satisfaction from PT *LoS* and its status as a *product* that provides some *value* for passenger *money*, are modelled as antecedents of car vs. bus mode use in this study. Moreover, the manifest variables of these exogenous latent variables "VfM" and "LoS" are also established. The seven research hypotheses below are thus formulated. These hypotheses are based on the travel theories in the above transit literature, such as utility/value-based theory (De Vos, Mokhtarian, Schwanen, Van Acker, & Witlox, 2016), customer attitude theories (Abenoza et al., 2017), expectation-confirmation (Fu et al., 2018) and planned-behaviour theory (Skarin et al., 2019).

**$H_1$:** *Passenger satisfaction from LoS is influenced by travel bias of passengers.*
**$H_2$:** *Passengers' perceived VfM of the bus service is related to their travel bias.*
**$H_3$:** *Travel bias of passengers affects their ranking of quality attributes.*
**$H_4$:** *Passengers' ranking of quality attributes positively affects perceived VfM of service.*
**$H_5$:** *Relative ranking of quality attributes is indicative of passenger satisfaction from LoS.*
**$H_6$:** *Passenger perceived VfM has a positive effect on their satisfaction from LoS.*
**$H_7$:** *Passengers' satisfaction from LoS positively affects their choice to travel by bus and negatively influences their car usage.*

## 4. METHOD

### 4.1 Travel survey location, procedure and sampling

Traditionally, data regarding travel patterns is collected through travel surveys (Guirao et al., 2016). They are broadly categorised into household and self-administered surveys, where the latter category is usually considered to remove most of the systematic bias (Taylor, Young, Wigan, & Ogden, 1992). The current analysis is based upon a travel dataset of intra-city bus passengers in the Emirate of Abu Dhabi, United Arab Emirates (UAE). Having witnessed a period of rapid growth following the oil-exploration era in the Middle East, it is quite similar to cities like Riyadh, Dubai, Kuwait City, etc., (Currie & De Gruyter, 2018; Mezghani, 2006), with a predominant reliance on private vehicles instead of PT.

Qamhaieh and Chakravarty (2020) note that Abu Dhabi contains 359 private vehicles for every 1000 residents compared to 68, 144, 101, 213 and 305 private vehicles per 1000 residents in cities like Mumbai, Shanghai, Singapore, London, and New York, respectively. International transport policy

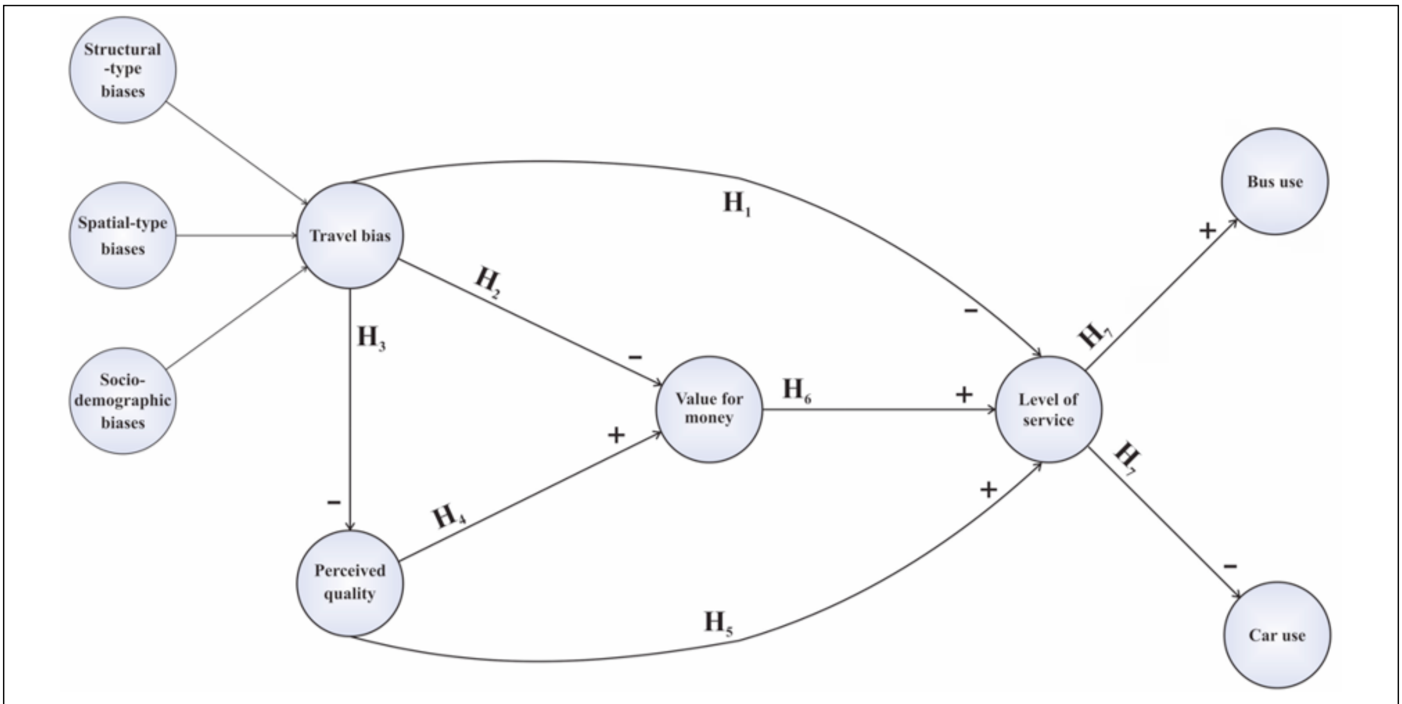


**Figure 1. Proposed structural equation model based on the research hypotheses.**

experts have noted that "there is very little urban space and service for pedestrians within the Abu Dhabi CBD when compared with European cities, be it for the climate, societal or cultural reasons" (DoT Abu Dhabi, 2009). The local population in Abu Dhabi and rest of the UAE have traditionally associated car ownership with modernity, social status and economic prosperity since the rapid modernization that began in 1970s. On the other hand, Buehler, Pucher, Gerike, and Götschi (2017) noted that the annual average car ownership growth rate in Europe and other OECD countries has been continuously declining since 1970, falling to the lowest in 2010s at 0.9% from 3.9% for 1970 – 1980.

Similarly, Qamhaieh and Chakravarty (2020) noted that although the socio-demographic, income level and cultural divisions in the society are visible in globalizing cities (such as Sydney, London, Paris, and New York), they are more apparent in the UAE due to large presence of expatriates. Nationals represent only 15% of Abu Dhabi's population, while expatriates (South Asians, East Asians, other Middle Easterners and Westerners) making up the majority (SCAD, 2014). These expatriates are employed in many industries, ranging from modestly paid labourers to professional class individuals. Many of these expatriates are already accustomed to wide-spread public transportation usage in their countries, thus other factors such as infrequent PT services, unreliable schedules, low network coverage, and overcrowded PT may be responsible for the strong car culture in Abu Dhabi and rest of the UAE (Hasan, Whyte, & Al Jassmi, 2018b). Alawadi and Benkraouda (2017) note that the cities in the UAE are designed as North American style suburban spaces with a notable resistance against dense urban residencies. This differentiates Abu Dhabi and other cities in UAE and other Gulf Cooperation Council countries (Saudi Arabia, Oman, Qatar, Kuwait, etc.) from their European counterparts where urban sprawl is dominant (Rahman et al., 2017; Dong et al., 2019). Another contributing factor could be the high temperature in Abu Dhabi that can reach above 45°C, hindering PT use (Qamhaieh & Chakravarty, 2020).

Past research (Hasan et al., 2018b, 2019) highlights that approximately 60% of trips in Abu Dhabi are performed using private cars. In comparison, 70% of peak-hour trips in other similar metropolitans such as Singapore are made by PT (DoT Abu Dhabi, 2009). This is despite the extension of paid parking zones (up to $1.5/hour, planned to be further hiked to $3/hour) in downtown area and removal of free parking in these locations. The PT fares have been fixed at a discounted rate of $1 per trip and the DoT Abu Dhabi is planning to further cut PT fares to either free or as low as $0.5 for the short-distance trips around downtown areas. These PT fare levels are significantly lower than those in other metropolitans from developed countries, such as up to $2.5 (for a non-concession daily trip ticket) in Sydney (Transport for NSW, 2021); and $1.88 – to $2.48 per trip in Singapore (SBS Transit Ltd., 2019). Thus, instead of *arbitrarily* adding more bus lines, reducing fares, or adding more bus-stations along the routes; this paper suggests that passenger mode choice, satisfaction and perception of travel service quality may be studied to advise local authorities in creating dedicated transport policies in favour of PT usage. Several meetings were held with the Abu Dhabi Department of Transport to gain a detailed understanding of the city and its passenger demographics.

Travel data was collected through on-board surveys as the study focuses on identifying factors that may discourage their bus travel patterns and may be improved to cause public bus transport uptake. a survey questionnaire (Table 1) was designed for soliciting travel information of existing bus users and their perception of the existing bus network, demographic profile of the service users and their respective attitude towards travelling attributes: network coverage, quality and satisfaction, level of fare and potential improvement strategies that may improve their bus ridership. The questionnaire was limited to 11 multiple-choice questions and 31 variables designed to take less than five minutes time.

The surveyed routes consisted of both outer urban and downtown city routes (Figure 2). Teams designated by Abu Dhabi Department of Transport were used to gather passenger travel behaviour and psychometric data for the passengers that travel along the pre-existing bus travel routes illustrated by coloured lines in Figure 2. The mode use and travel bias (structural-type, spatial-type and socio-demo-

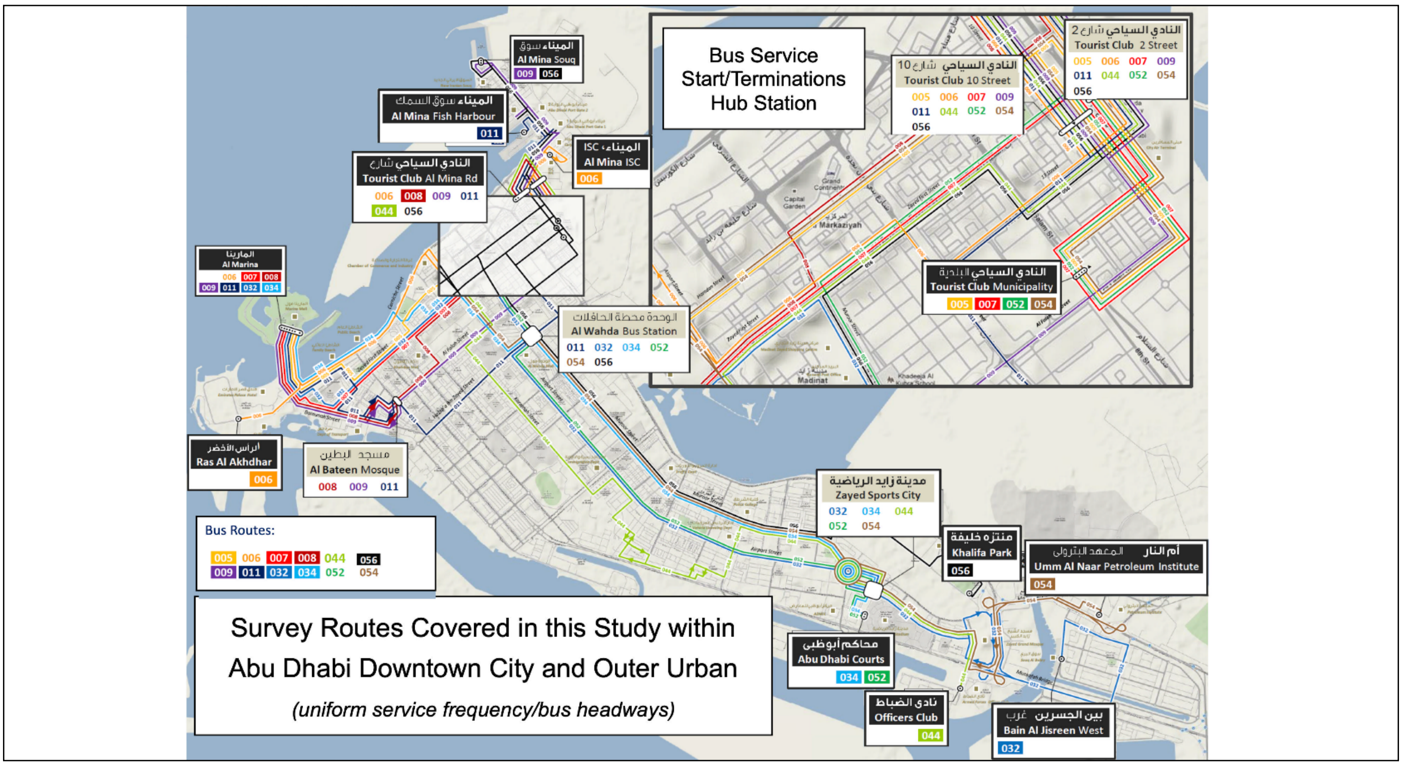


**Figure 2. Surveyed outer urban and downtown bus routes (based on plans from Abu Dhabi DoT).**

| No. | Questions | Responses (Please circle as appropriate) | | | | | | |
|---|---|---|---|---|---|---|---|---|
| **MU** | ***Mode use variables*** | | | | | | | |
| MU1 | How often do you travel by bus? | 1. First time | 2. Less often | 3. 1–3 times/month | 4. Once a week | 5. 2–4 times/week | 6. Over 5 times/week | 7. Never |
| MU2 | How often do you travel by private car or taxi? | 1. First time | 2. Less often | 3. 1–3 times/month | 4. Once a week | 5. 2–4 times/week | 6. Over 5 times/week | 7. Never |
| **LoS** | ***Level of service variables*** | | | | | | | |
| LoS1 | How satisfied are you with the current frequency of buses on this route? | 1. Very dissatisfied | 2. Dissatisfied | 3. Neutral | 4. Satisfied | 5. Very satisfied | | |
| LoS2 | How satisfied are you with the current level of network coverage on this route? | 1. Very dissatisfied | 2. Dissatisfied | 3. Neutral | 4. Satisfied | 5. Very satisfied | | |
| **VfM** | ***Value for money variables*** | | | | | | | |
| VfM1 | How satisfied are you with the current quality of ride on buses on this route? | 1. Very dissatisfied | 2. Dissatisfied | 3. Neutral | 4. Satisfied | 5. Very satisfied | | |
| VfM2 | How satisfied are you with the current level of fare of buses on this route? | 1. Very dissatisfied | 2. Dissatisfied | 3. Neutral | 4. Satisfied | 5. Very satisfied | | |
| **ST** | ***Travel Bias (Structural-type Constraints Questions)*** | | | | | | | |
| ST1 | Your accommodation type? | 1. Villa | 2. Apartment | 3. Hotel | 4. Labour camp | 5. Other | | |
| ST2 | What is your employment status? | 1. Retired/Other | 2. Visitor | 3. Student | 4. Unemployed | 5. Work part-time | 6. Work full-time | |
| ST3 | What is your annual rent? (AED) | 1. Under 10,000 | 2. 10,000–20,000 | 3. 20,001–40,000 | 4. 40,001–60,000 | 5. 60,001–100,000 | 6. Over 100,000 | |
| **SP** | ***Travel Bias (Spatial-type Constraints Questions)*** | | | | | | | |
| SP1 | Where do you live? | 1. Al-Bateen | 2. Downtown | 3. CBD | 4. Al-Mina | 5. Al-Wahdah | 6. Shakhbout St to city edge | 7. Out of city |
| SP2 | Where did you start this journey? | 1. Al-Bateen | 2. Downtown | 3. CBD | 4. Al-Mina | 5. Al-Wahdah | 6. Shakhbout St to city edge | 7. Out of city |
| SP3 | Where are you travelling to? | 1. Al-Bateen | 2. Downtown | 3. CBD | 4. Al-Mina | 5. Al-Wahdah | 6. Shakhbout St to city edge | 7. Out of city |
| SP4 | Purpose of your journey today? | 1. Work | 2. Study | 3. Business | 4. Personal reason | 5. Shopping | 6. Leisure | |
| SP5 | Type of ticket you purchased today. | 1. Cash | 2. Daily pass | 3. Monthly pass | 4. Seniors pass | 5. Disability pass | | |
| **SD** | ***Travel Bias (Socio-demographic Constraints Questions)*** | | | | | | | |
| SD1 | Age (years) | 1. Under 16 | 2. 16 – 24 | 3. 25 – 34 | 4. 35 – 44 | 5. 45 – 64 | 6. Over 65 | |
| SD2 | Number of cars in the household | 1. No cars | 2. 1 to 2 cars | 3. 3 to 5 cars | 4. Over 5 cars | | | |
| SD3 | Do you hold a UAE driving license? | 1. Yes | 2. No | | | | | |
| SD4 | Ethnicity/Nationality | 1. UAE | 2. Caucasian | 3. Middle Eastern | 4. African | 5. South Asian | 6. Southeast Asia | 7. Other |
| SD5 | Gender | 1. Male | 2. Female | | | | | |
| SD6 | Your gross monthly income in AED | 1. Under 10,000 | 2. 1,000–3,000 | 3. 3,001–5,000 | 4. 5,001–10,000 | 5. 10,001–20,000 | 6. Over 20,000 | |

| SQ | *Perceived Service Quality Questions* | | | | | |
|---|---|---|---|---|---|---|
| SQ1 | I am satisfied with the journey time | 1. Strongly disagree | 2. Disagree | 3. Neutral | 4. Agree | 5. Strongly agree |
| SQ2 | The buses are too crowded | 1. Strongly disagree | 2. Disagree | 3. Neutral | 4. Agree | 5. Strongly agree |
| SQ3 | Bus travel is the easiest way for me | 1. Strongly disagree | 2. Disagree | 3. Neutral | 4. Agree | 5. Strongly agree |
| SQ4 | I am satisfied with the bus-stops | 1. Strongly disagree | 2. Disagree | 3. Neutral | 4. Agree | 5. Strongly agree |
| SQ5 | Travel by car or taxi is expensive | 1. Strongly disagree | 2. Disagree | 3. Neutral | 4. Agree | 5. Strongly agree |
| SQ6 | Traffic congestion delays my journey | 1. Strongly disagree | 2. Disagree | 3. Neutral | 4. Agree | 5. Strongly agree |
| SQ7 | I chose to live further from work (i.e., near family and friends) and longer commute time is insignificant to me | 1. Strongly disagree | 2. Disagree | 3. Neutral | 4. Agree | 5. Strongly agree |
| SQ8 | I chose to live closer to work as shorter commute time is significant to me | 1. Strongly disagree | 2. Disagree | 3. Neutral | 4. Agree | 5. Strongly agree |
| SQ9 | Willing to pay more for bus travel if I always had a seat | 1. Strongly disagree | 2. Disagree | 3. Neutral | 4. Agree | 5. Strongly agree |
| SQ10 | I am satisfied with the existing distribution of bus-stops on the current travel route (Today it took me longer/many minutes to get to bus-stop) | 1. Strongly disagree (over 25 min) | 2. Disagree (16 to 25 min) | 3. Neutral (10 to 15 min) | 4. Agree (5 to 10 min) | 5. Strongly agree (under 5 min) |

**Table 1. Questionnaire sample (English version) used for this study.**

graphic) questions were coded for categorical responses and perceived quality attributes were based on a Likert-type scale ranging from "*1 = strongly disagree*" to "*5 = strongly agree*" and LoS and VfM were measured on a Likert-type satisfaction scale.

The survey procedure primarily focused on capturing intra-city travellers, based on the DoT observations, in an area between Corniche and Hazaa Bin Zayed. It was noted that as some car users may be unaware of the existing quality of PT service and its attributes (due to having never used the service), their responses may introduce an unintentional systematic bias in the results. Conversely, if the survey is predominantly focused on bus users, it may also introduce some systematic bias. However, based on the expert opinions at the Abu Dhabi Department of Transport, the survey was primarily aimed to capture the data of bus travellers with data skewed towards bus travellers necessarily as the improved service was planned to first retain existing users and improve their perception of the service. This may in turn enhance their willingness to promote PT service to non-users through word-of-mouth, as has been noted by other researchers (Yuda Bakti et al., 2020). To increase the range of the collected sample, interviews were conducted on both weekdays and weekends under two eight-hour shifts. a total of 769 interviews for weekend and 751 interviews for weekdays were completed (incomplete questionnaires were discarded). Two eight-hour shifts, 6am to 2pm and 2pm to 10pm were undertaken to complete the fieldwork to collect responses from a diversified group of passengers. As per the local department of transport policies, the survey respondents were selected at random and were not paid. In addition to data screening and filtration by the authors, Abu Dhabi DoT experts (in 2015) initially reviewed the collected raw data to facilitate validity (Şimşekoğlu, Nordfjærn, & Rundmo, 2015) of the questionnaire responses.

## 5. DATA ANALYSIS

In the current study, *mode use* is conceptualised as a function of latent variable *satisfaction with LoS*, itself a consequence of latent variable *perceived VfM* of the existing bus service. As stated earlier, SEM is frequently used to calculate the latent variables in a collected dataset that may be otherwise unobservable through direct estimations. For example, de Oña, de Oña, Eboli, and Mazzulla (2013) used SEM analysis to estimate the latent "passenger satisfaction" variable from the manifest "bus service quality" variables. Traditionally, a multivariate normal distribution is assumed in the collected manifest variables and linear structural relationship is used to develop the relationship model. This practice has been debated by other researchers (Shen et al., 2016). They have argued that the data collected through travel surveys rarely follow this distribution and the observed variables are usually dependent on each other, which can only be modelled using modified SEM technique.

Partial Least Squares (PLS) method for SEM has little reliance on normal distribution assumptions and can be used to explicitly estimate the latent variables. It is also more suitable for the work presented here due to its ability to handle complicated models with both formative (where indicators *cause* latent variable) and reflective (where latent variable *cause* indicators) constructs (Hair, Sarstedt, Ringle, & Mena, 2012). SmartPLS 3.2.6 (Ringle, Wende, & Becker, 2015) was used in this work to validate the hypotheses by explaining the presence of a causal relationship between the variable constructs. Following the above literature review, this work modelled "*Travel Bias*" as a second-order formative construct (where indicators are also latent variables) with endogenous variable constructs of spatial, structural and socio-demographic constraints. The latent variable of "*Perceived Quality*" constituted the second formative construct with some of the most used quality attributes as exogenous variables. VfM, satisfaction from LoS and frequency of bus and car travel were modelled here as reflective constructs. All the exogenous variables remained independent throughout the model. The framework is shown in Figure 1 and the model is composed of two components, both used to confirm the validity of our hypotheses. First, the measurement model describing the relationship between the latent variable and manifest variables of a formative construct, defined as:

(1) $x = \Lambda_x \xi + \delta$

for exogenous variables with structural coefficient matrix $q \times n$ by $\Lambda_x$

(2) $y = \Lambda_y \eta + \varepsilon$

for endogenous variables with structural coefficient matrix by $p \times m$ with a second, structural model describing the relationship between the different constructs themselves, defined as:

(3) $y = \beta\eta + \Gamma\xi + \zeta$

Where, the endogenous latent variable vector $m \times 1$ is defined by $\eta$, path coefficient $m \times m$ matrix by $\beta$, residual $m \times 1$ vector by $\zeta$ with $m \times n$ path coefficient matrix $\Gamma$ and, the exogenous latent variable $n \times 1$ vector by $\xi$. The number of structural model equations depends upon the number of endogenous latent variables. Equations (1) – (3) are a simplified version of the PLS equations (Henseler, Hubona, & Ray, 2016) in behavioural data sciences and statistical analyses, to define the relationship between the variables modelled through a PLS algorithm.

## 6. RESULTS AND DISCUSSION

### 6.1 Socio-demographic distribution of passengers

Table 2 shows the detailed passenger distribution while the results for observed travel mode frequency (bus and cars) is shown in Figure 3. These statistical distribution results are provided to not only characterize the surveyed population but also validate the findings of this study against already published research in terms of "local population representation". Initial descriptive statistical analysis suggests that traveller distribution was skewed towards males (86%-weekdays and 89%-weekends) of South-Asian descent (57%, 57%). This demographic distribution is representative of the Abu Dhabi city population; where more than 50% residents are of South Asian descent, 66% are under 34 years old, 62% are male with an average salary under 3500 AED/month (SCAD, 2018; Tong, 2017). Survey respondents predominantly (82.5%) fall into the fulltime workforce category (ST2 mean=5.55), that earned an average gross monthly income in the range of 1,000-5,000 dirhams (SD6 mean=2.47). These results are similar to the findings in a detailed report (Daleure, 2017), where majority of Abu Dhabi's population was found to be expatriate fulltime workers, and a mean monthly salary in the Emirate of Abu Dhabi was found to be 3500 dirhams.

Similarly, majority of the respondents lived in apartments (ST1 mean=2.5), which is representative of the Abu Dhabi population (Hasan et al., 2018b). Most of the respondents agreed that buses were not crowded (SQ2 mean=0.6), still, bus travel was not the easiest mode for them (SQ3 mean=0.66). This can be explained by the following reasons. Firstly, the respondents were largely dissatisfied with the existing bus-stop distribution (SQ10 mean=2.10), which implies that they travelled more than

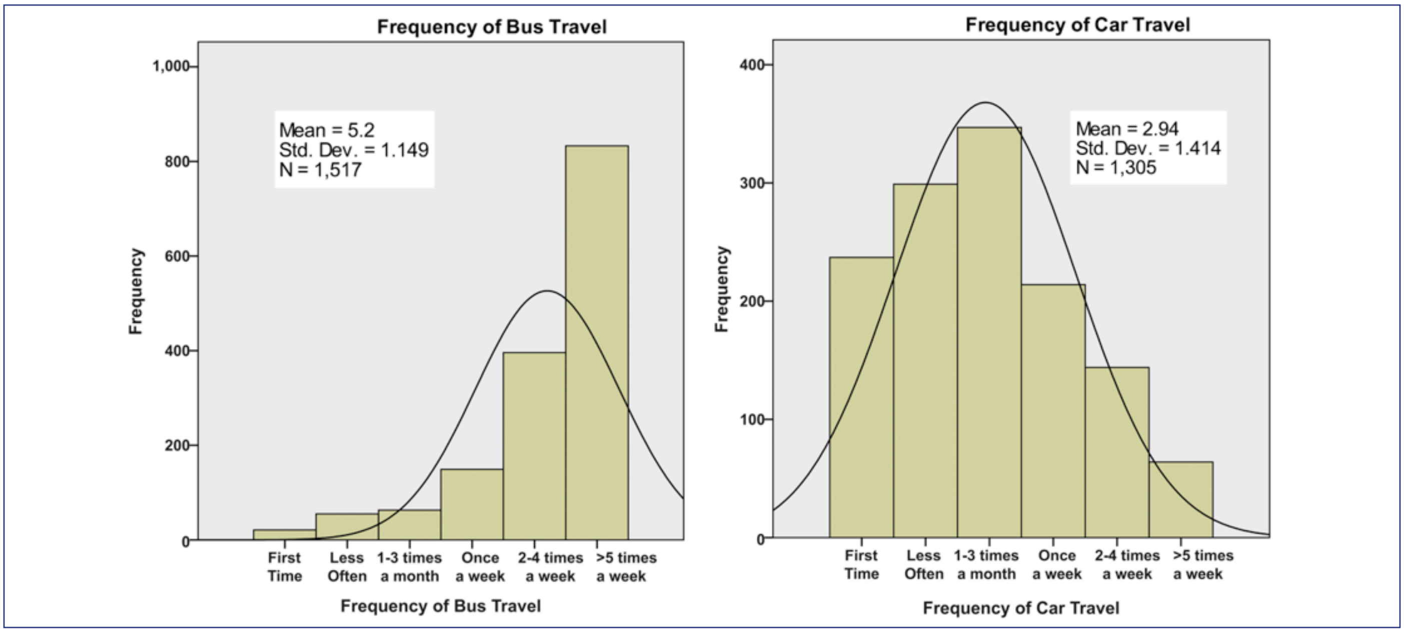


**Figure 3. Distribution of frequencies of bus and car travel among the surveyed passengers.**

| No. | Variables | Valid Cases | Mean | Standard Deviation | Variance |
|---|---|---|---|---|---|
| MU1 | Frequency of bus travel | 1517 | 5.20 | 1.149 | 1.321 |
| MU2 | Frequency of car travel | 1305 | 2.94 | 1.414 | 2.000 |
| LoS1 | Satisfaction with frequency of buses | 1512 | 3.70 | 0.899 | 0.809 |
| LoS2 | Satisfaction with network coverage | 1494 | 3.74 | 0.890 | 0.793 |
| VfM1 | Satisfaction with quality of ride | 1501 | 3.98 | 0.976 | 0.953 |
| VfM2 | Satisfaction with level of fare | 1505 | 3.37 | 1.351 | 1.824 |
| ST1 | Your accommodation type? | 1509 | 2.52 | 1.390 | 1.933 |
| ST2 | What is your employment status? | 1505 | 5.55 | 1.103 | 1.216 |
| ST3 | What is your annual rent? (AED) | 1384 | 2.09 | 1.252 | 1.566 |
| SP1 | Where do you live? | 1519 | 3.76 | 1.814 | 3.291 |
| SP2 | Where did you start this journey? | 1518 | 3.35 | 1.845 | 3.405 |
| SP3 | Where are you travelling to? | 1515 | 3.38 | 1.823 | 3.323 |
| SP4 | Purpose of your journey today? | 1514 | 3.25 | 2.130 | 4.539 |
| SP5 | Type of ticket you purchased today | 1516 | 1.32 | 0.732 | 0.536 |
| SD1 | Age (years) | 1507 | 3.21 | 0.923 | 0.851 |
| SD2 | Number of cars in household | 1440 | 0.17 | 0.392 | 0.153 |
| SD3 | Do you hold a UAE driving license? | 1503 | 1.79 | 0.411 | 0.169 |
| SD4 | Ethnicity/Nationality | 1507 | 5.02 | 1.070 | 1.145 |
| SD5 | Gender | 1509 | 1.13 | 0.333 | 0.111 |
| SD6 | Your gross monthly income in AED | 1385 | 2.47 | 1.048 | 1.099 |
| SQ1 | I am satisfied with the journey time | 1508 | 3.95 | 0.826 | 0.682 |
| SQ2 | The buses are too crowded | 1519 | 0.60 | 0.489 | 0.240 |
| SQ3 | Bus travel is the easiest way for me | 1519 | 0.66 | 0.475 | 0.226 |
| SQ4 | I am satisfied with the bus-stops | 1496 | 3.38 | 1.125 | 1.265 |
| SQ5 | Travel by car or taxi is expensive | 1519 | 0.45 | 0.497 | 0.247 |
| SQ6 | Traffic congestion delays my journey | 1519 | 0.35 | 0.478 | 0.228 |
| SQ7 | I chose to live further from work | 1519 | 0.66 | 0.472 | 0.223 |
| SQ8 | I chose to live closer to work | 1319 | 4.70 | 2.70 | 7.301 |
| SQ9 | Willing to pay more for bus seat | 1519 | 0.36 | 0.479 | 0.229 |
| SQ10 | Satisfied with existing bus-stop distribution | 1519 | 2.10 | 0.676 | 0.457 |

**Table 2. Statistical descriptive distribution of the collected variables.**

16 minutes to reach the nearest bus-stop. Secondly, majority of the respondents either had a neutral perception or agreed with the existing bus-stop quality (SQ4 mean=3.35) and journey time (SQ1 mean=3.95). Additionally, similar perceptions of the frequency of buses, quality of ride and fare level were observed. a separate study by the authors (Hasan et al., 2018b) found that the passengers' perception of journey time and fare level were highly correlated to the ride quality rating, and longer journey time resulted in a negative service perception. This implies that journey time and service value must be optimised to attract the dissatisfied passengers.

The authors (Hasan et al., 2018b) also found that passengers dissatisfied with the bus service and frequent car users still viewed buses as overcrowded and having inadequate service frequency. Similarly, most passengers lived (SP1 mean=3.76), started (SP2 mean=3.35) and ended (SP3 mean=3.38) their journey around the CBD region. This can be explained by most passengers choosing to live close to work (SQ8 mean=4.7), which is also a representative choice of the residents in the studied region (AECOM, 2015). Moreover, this resulted in traffic congestion being a smaller concern among the survey respondents (SQ6 mean=0.35). Yet, the authors (Hasan et al., 2018b) found that the respondents concerned with traffic congestion-related delays stilled formed a significant share among dissatisfied passengers and were correlated with the respondents demanding a rapid bus service (which is currently unavailable on the studied routes).

### 6.2 Evaluation of measurement model

Measurement models are analysed using construct reliability, convergent validity, and discriminant validity tests. Since this study recognises both formative and reflective constructs, only measures related to the specific constructs were used. In contrast to reflective constructs, very few guidelines exist for validating formative constructs. *Travel bias* was a second-order formative construct, with formative sub-constructs of *spatial*, *structural* and *socio-demographics*, its validity was checked following Benbasat and Wang (2005), these were replaced by their respective latent variable scores from SmartPLS. To check construct reliability, bootstrapping (random sampling with replacements) was performed with SmartPLS to check absence of multi-collinearity and validity of the indicators, following the guidelines by Andreev, Heart, Maoz, and Pliskin (2009). Indicator validity was tested using t-statistics values of path coefficients (Figure 4). Only origin and residential areas, employment status and possession of driving license were noted as somewhat insignificant indicators.

Variance inflation factors (VIF) scores were used to test for multi-collinearity. The VIF values ranged from 1.017 – 1.796 (Table 3), which confirms that all formative latent variables met the required thresholds of VIF<10 (Henseler et al., 2016) with no multi-collinearity present. The convergent and discriminant validity of the formative constructs was assessed using the multitrait-multimethod matrix approach (Andreev et al., 2009) in a two-step process. First, SPSS 13 was used to obtain the standardised scores of all manifest variables, and the standardised weights of the first- and second-order formative constructs were extracted from SmartPLS. These two values were then multiplied to obtain the weighted manifest variables and then summed up to obtain the respective composite construct scores.

Campbell and Fiske (1959) postulated that the manifest variables belonging to the same construct should be significantly correlated with each other, compared to the indicators of other constructs. Generally, the indicators of travel bias exhibited a high correlation with inter-measure indicators rather than the perceived quality construct, thus confirming the convergent validity of the instrument. However, due to the presence of some correlations between different indicators of the three sub-constructs (structural, spatial and socio-demographic), some of the indicators of sub-constructs displayed stronger correlations with those belonging to the other sub-construct. For example, respondents from high-income groups also occupied high rental properties, yet were not necessarily fulltime employed. Findings such as these, although technically violate the threshold can be easily explained by the factors unique to the Emirate of Abu Dhabi such as having more business owners living in high rental apartments. Previous studies employing the same methodology (e.g., Loch, Straub, and Kamel (2003)) have proposed similar arguments for identifying false red flags in the analysis results. Reflective constructs of *VfM*, *satisfaction from LoS*, *frequency of bus travel* and *frequency of car travel* were examined for composite reliability and internal

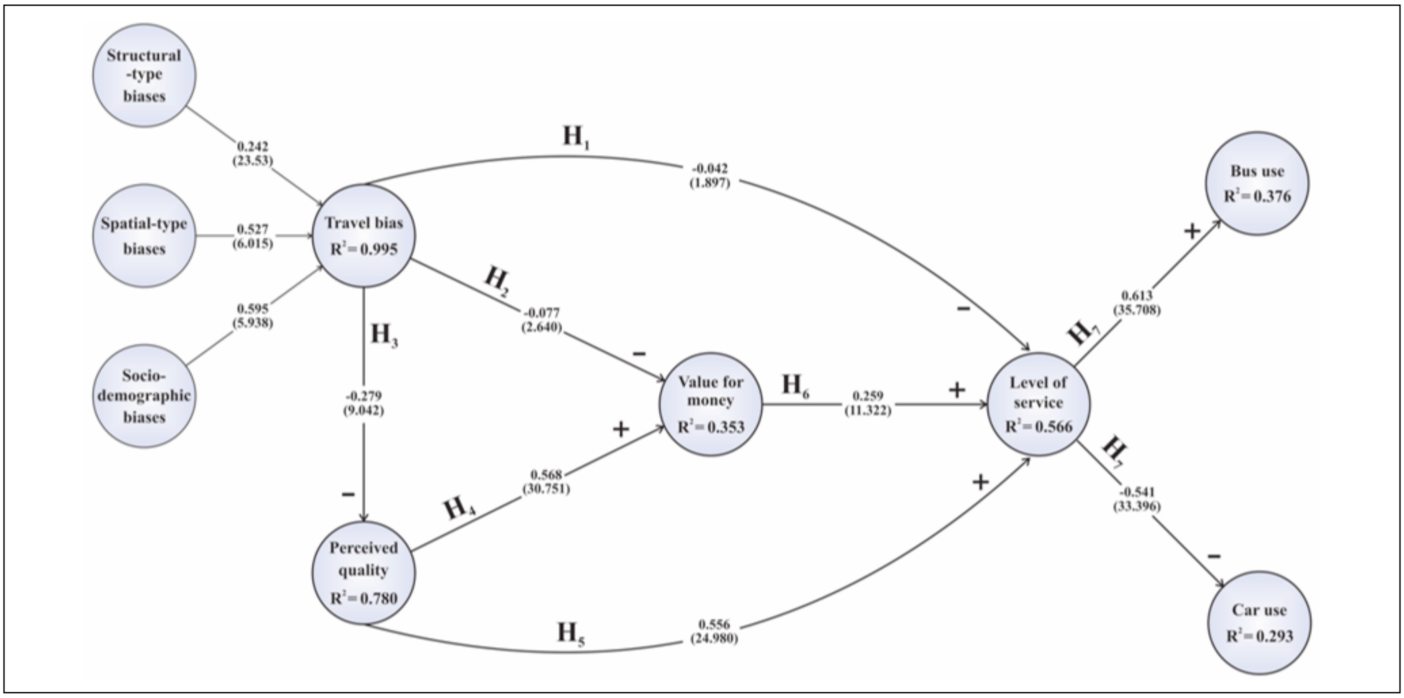


**Figure 4. PLS analysis results for the proposed structural equation model.**

consistency through Cronbach's alpha. Convergent and discriminant validity were also examined by the average variance extracted (AVE).

Results (Table 4) exhibit that all composite reliability and Cronbach's alpha scores were above the recommended minimum threshold of 0.7 (Hair et al., 2012), indicating that internal consistency and reliability were confirmed. As all AVE values were above the 0.5 cut-off (Hair et al., 2012), the convergent validity of the constructs was also established. The bolded values along the diagonals in Table 4 show the square-roots of AVE for each construct (e.g., 0.896 for LoS). For the discriminant validity to be true, these values should exceed the inter-construct correlations (Kim, Lee, & Bonn, 2017), which was also confirmed. Overall, even though there were some violations in the measurement models, the constructs had appropriate validity and most of the indicators passed the required reliability and validity tests. Furthermore, the violations were explainable due to the nature of the data. This exhibits an ability to significantly define the respective latent variable constructs and as such the current study was then able to proceed to test the research hypotheses by evaluating the structural model.

### 6.3 Evaluation of structural model: hypotheses testing

The results of the PLS structural model are shown in Figure 4. Henseler et al. (2016) recommend that the primary criterion for assessing the validity of a structural model is "explained variance level" based on $R^2$ values of the endogenous latent variable constructs. The non-parametric method of bootstrapping was conducted, which performs re-sampling to evaluate the significance and conformance of the model (Kim et al., 2017). The $R^2$ values of the endogenous latent variables are illustrated in Figure 4 and most of the values were in the 0.376 – 0.995 range, showing a substantial degree of overall

| First-order constructs | Second-order formative sub-constructs | Path Coefficient | Sample mean | SD | t-statistics | VIF |
|---|---|---|---|---|---|---|
| *Travel bias* | *Structural – type travel biases* | | | | | |
| | Your accommodation type? | 0.349 | 0.336 | 0.138 | 2.527** | 1.792 |
| | What is your employment status? | 0.193 | 0.202 | 0.132 | 1.467 | 1.796 |
| | What is your annual rent? (in dirham) | 0.805 | 0.795 | 0.073 | 11.024*** | 1.017 |
| | *Spatial – type travel biases* | | | | | |
| | Where do you live? | 0.200 | 0.188 | 0.11 | 1.818 | 1.075 |
| | Where did you start this journey? | 0.145 | 0.136 | 0.103 | 1.401 | 1.061 |
| | Where are you travelling to? | 0.402 | 0.396 | 0.087 | 4.593*** | 1.024 |
| | Purpose of your journey today? | 0.698 | 0.686 | 0.07 | 9.953*** | 1.045 |
| | Type of ticket you purchased today. | 0.304 | 0.305 | 0.083 | 3.646*** | 1.023 |
| | *Socio-demographic travel biases* | | | | | |
| | Age (years) | 0.171 | -0.164 | 0.071 | 2.401* | 1.039 |
| | Number of cars in household | 0.277 | 0.272 | 0.088 | 31.16** | 1.287 |
| | Do you hold a UAE driving license? | 0.031 | 0.028 | 0.091 | 0.347 | 1.343 |
| | Ethnicity/Nationality | 0.626 | 0.616 | 0.068 | 9.196*** | 1.085 |
| | Gender | 0.405 | -0.411 | 0.08 | 5.042*** | 1.019 |
| | Your gross monthly income in AED? | 0.309 | 0.29 | 0.104 | 2.964** | 1.155 |
| *Perceived quality* | I am satisfied with journey time? | 0.649 | 0.648 | 0.028 | 22.841*** | 1.23 |
| | The buses are too crowded | -0.015 | -0.104 | 0.027 | 3.864*** | 1.226 |
| | Bus travel is the easiest way for me | 0.068 | 0.069 | 0.026 | 2.64** | 1.105 |
| | I am satisfied with the bus-stops | 0.504 | 0.501 | 0.029 | 17.57*** | 1.24 |
| | Travel by car or taxi is expensive | -0.014 | -0.013 | 0.028 | 2.489** | 1.204 |
| | I chose to live further from work | 0.026 | 0.027 | 0.027 | 1.975** | 1.243 |
| | I chose to live close to work | 0.048 | 0.048 | 0.027 | 1.966*** | 1.169 |
| | Pay more to travel by bus for a seat | -0.015 | -0.016 | 0.026 | 2.571* | 1.283 |
| | Satisfied with bus-stops' distribution | 0.070 | 0.069 | 0.024 | 2.974** | 1.019 |
| | Traffic congestion delays my journey | 0.026 | 0.026 | 0.025 | 3.029** | 1.114 |

SD = Standard deviation. *Listed values are for second-order formative constructs.* *** $p < 0.001$, ** $0.001 \le p < 0.01$, * $p < 0.05$.

**Table 3. Path analysis and multi-collinearity results.**

| Constructs | Composite reliability | Cronbach's alpha | AVE | Correlations | | | |
|---|---|---|---|---|---|---|---|
| | | | | LoS | VfM | Car | Bus |
| Level of service (LoS) | 0.891 | 0.757 | 0.804 | *0.896* | | | |
| Value for money (VfM) | 0.781 | 0.745 | 0.647 | 0.597 | *0.804* | | |
| Car use (Car) | 0.712 | 0.726 | 0.616 | -0.553 | -0.311 | *0.785* | |
| Bus use (Bus) | 0.773 | 0.849 | 0.724 | -0.613 | -0.434 | 0.669 | *0.851* |

**Table 4. Path analysis and multi-collinearity results.**

| Hypotheses | | β | t-statistic | Outcome |
|---|---|---|---|---|
| **$H_1$:** Passenger satisfaction from LoS is influenced by travel bias of passengers. | | $-0.042^{*}$ | 1.897 | Invalid |
| **$H_2$:** Passengers' perceived VfM of the bus service is related to their travel bias. | | $-0.077^{**}$ | 2.640 | Validated |
| **$H_3$:** Travel bias of passengers affects their ranking of quality attributes. | | $-0.279^{***}$ | 9.042 | Validated |
| **$H_4$:** Passengers' ranking of quality attributes positively affects perceived VfM of the service. | | $0.568^{***}$ | 30.751 | Validated |
| **$H_5$:** Relative ranking of quality attributes is indicative of passenger satisfaction from LoS. | | $0.556^{***}$ | 24.980 | Validated |
| **$H_6$:** Passenger perceived VfM has a positive effect on their satisfaction from LoS. | | $0.259^{***}$ | 11.322 | Validated |
| **$H_7$:** Passengers' satisfaction from LoS positively affects their choice to travel by bus and negatively influences their car usage. | *Bus* | $0.613^{***}$ | 35.708 | Validated |
| | *Car* | | | |

*** $p < 0.001$, ** $0.001 \le p < 0.01$, * $p > 0.05$

**Table 5. Hypotheses testing results.**

goodness-of-fit. The criteria specified by Chin (1998) proposes that an $R^2$ value between 0.33 – 0.66 indicated a moderate estimation while lower and higher values respectively describe a weak and substantial estimation.

Although the manifest variables from the "car use" latent variable passed the significance criteria, the latent variable itself had a low $R^2$ value, probably due to the comparatively lower response rate in the collected sample. Hypotheses testing results in Table 5 show that all the proposed hypotheses were supported except hypothesis $H_1$, which failed both t-statistics and p-value tests. Although the travel bias of passengers negatively influenced their perceived VfM ($H_2$: path coefficient = – 0.077, $p<0.01$), its influence on their satisfaction from LoS was not supported ($H_1$: path coefficient = – 0.042, *p-value* 0.06), which invalidated $H_1$. However, as the hypothesis marginally failed the pass criteria, a further in-depth investigation may be needed.

Results confirmed $H_3$ that the travel biases of passengers reduced their perception of quality attributes. It leads to the argument that passengers on a bus service were less likely to positively appraise the service quality depending upon their individual characteristics and any policy strategies should also consider these variables to attract the itinerant market. Also, the quality attributes positively affected the VfM of the bus service as perceived by the passengers, validating $H_4$.

Passenger satisfaction from the LoS was found to be substantially affected by the service quality attributes ($H_5$: path coefficient = 0.556, $p < 0.001$). The perceived VfM had a strong influence on satisfaction from LoS ($H_6$: path coefficient = 0.259, $p < 0.001$) which subsequently affected the mode use. The role of passenger satisfaction in defining the mode choice of passengers was investigated by $H_7$. Overall, the frequency of bus use increased as the LoS satisfaction also increased whereas the tendency of respondents to opt for car travel reduced with the escalating satisfaction levels. Furthermore, all the manifest variables of the latent variables *perceived VfM* and *LoS satisfaction* were also significant. This study's results propose that both latent variable constructs influenced mode use and were respectively described by the manifest variable groups of "*ride quality* and *level of fare*" and "*frequency of buses* and *network coverage*".

Drawing upon these findings, it may be postulated that any future analysis aimed at analysing passenger surveys to discover critical factors that can attract existing passengers more towards PT to reduce private vehicle use, may study the market based upon their current mode use and its relationship with these variables, as they were significant in defining the passenger behaviour.

## 7. CONCLUSION AND FUTURE RESEARCH DIRECTION

This study builds upon prior research on consumer psychometrics and transport studies to represent passenger satisfaction as a function of perceived value, service quality attributes and passenger travel bias. The bus or car use frequencies of passengers were established as the two model consequences through Abu Dhabi passenger response survey data. The validity of these hypotheses between the various endogenous latent variables (mode choice, LoS, VfM, quality attributes and travel bias) and their manifest variables, was then tested.

The results show strong effects of bus service quality attributes, notably journey time and bus-stop waiting area distribution and quality as a reinforcing factor for perceived value and satisfaction. Additionally, infrequent and overcrowded buses inhibited PT as a viable choice for some respondents. Travel bias held by passengers influenced perceived quality and its consequences (perceived VfM and LoS satisfaction). Overall, this study contributes to a theoretical understanding of passenger behaviour in not only Abu Dhabi city but also similar Middle East and North African cities with globalised demographic and developed infrastructure. The research model developed in this study can be used by transport policymakers to extend the findings of this study to other cities by identifying transit service variables critical for PT uptake in any region.

The research model and hypotheses testing results from this study can be used to identify effective improvement policies. From a marketing perspective, transit agencies should target office workforce passengers, particularly aimed at encouraging bus use for work-related trips. Another potential policy is that instead of extending the existing bus network, more bus-stops of adequate quality may be established along the existing routes to reduce travel time to the nearest bus-stops. The study also recommends that since journey time, ride quality and bus service frequency perceptions were correlated, the policymakers can improve service frequency around CBD region to target car users that are largely dissatisfied due to less-frequent service. Additionally, ride quality and comfort level should also be improved to enhance the perception of bus transit as a "valuable" service to the passengers. The combined effect of these policies can present the public bus transport as a tangible mode choice to the general populace, but more so for the regular commuters to reduce private car usage.

Some caveats from this study are recognised. Firstly, passengers' responses are in the context of the populace in Abu Dhabi and may be bound by the cultural, climatic and behavioural constraints of the region. Notably, the hot climate, where walking and bicycling over long distances are deemed untenable. Secondly, some variables that were excluded due to study scope and survey limits, such as transit safety, technology integration (e.g., autonomous vehicles), environmental attitude, information access, etc., can be included to derive further research hypotheses from literature and modify the model to suit other regional public transit issues.

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## REFERENCES

Abenoza, R. F., Cats, O., & Susilo, Y. O. (2017). Travel satisfaction with public transport: Determinants, user classes, regional disparities and their evolution. *Transportation Research Part A: Policy and Practice, 95*, 64-84. DOI: 10.1016/j.tra.2016.11.011

Abou-Zeid, M., & Fujii, S. (2016). Travel satisfaction effects of changes in public transport usage. *Transportation, 43*(2), 301-314. DOI: 10.1007/s11116-015-9576-3

AECOM. (2015). *Working Paper No. 1: Task 3 Review and Recommendations on the Proposed Travel Surveys*. Abu Dhabi, United Arab Emirates

Alawadi, K., & Benkraouda, O. (2017). The Debate over Neighborhood Density in Dubai: Between Theory and Practicality. *Journal of Planning Education and Research, 39*(1), 18-34. DOI: 10.1177/0739456X17720490

Andreev, P., Heart, T., Maoz, H., & Pliskin, N. (2009). *Validating formative partial least squares (PLS) models: Methodological review and empirical illustration.* Paper presented at the 13th International Conference on Information Systems, Phoenix, Arizona

Beirão, G., & Cabral, J. S. (2007). Understanding attitudes towards public transport and private car: a qualitative study. *Transport Policy, 14*(6), 478-489

Benbasat, I., & Wang, W. (2005). Trust in and adoption of online recommendation agents. *Journal of the Association for Information Systems, 6*(3), 4

Buehler, R., Pucher, J., Gerike, R., & Götschi, T. (2017). Reducing car dependence in the heart of Europe: lessons from Germany, Austria, and Switzerland. *Transport Reviews, 37*(1), 4-28. DOI: 10.1080/01441647.2016.1177799

Campbell, D. T., & Fiske, D. W. (1959). Convergent and discriminant validation by the multitrait-multimethod matrix. *Psychological Bulletin, 56*(2), 81-105

Chaloux, N., Boisjoly, G., Grisé, E., El-Geneidy, A., & Levinson, D. (2019). I only get some satisfaction: Introducing satisfaction into measures of accessibility. *Transportation Research Part F: Traffic Psychology and Behaviour, 62*, 833-843. DOI: 10.1016/j.trf.2019.03.008

Chin, W. W. (1998). The partial least squares approach to structural equation modeling. In G. A. Marcoulides (Ed.), *Modern methods for business research* (Vol. 295, pp. 295-336). London, U.K.: Lawrence Erlbaum Associates

Currie, G., & De Gruyter, C. (2018). Exploring links between the sustainability performance of urban public transport and land use in international cities. *Journal of Transport and Land Use, 11*(1), 325–342. DOI: 10.5198/jtlu.2018.957

Daleure, G. (2017). Wages, Salaries, and Expatriate Labor. In *Emiratization in the UAE Labor Market* (pp. 57-71): Springer

de Oña, J., de Oña, R., Eboli, L., & Mazzulla, G. (2013). Perceived service quality in bus transit service: a structural equation approach. *Transport Policy, 29*, 219-226

De Vos, J., Mokhtarian, P. L., Schwanen, T., Van Acker, V., & Witlox, F. (2016). Travel mode choice and travel satisfaction: bridging the gap between decision utility and experienced utility. *Transportation, 43*(5), 771-796. DOI: 10.1007/s11116-015-9619-9

dell'Olio, L., Ibeas, A., & Cecin, P. (2011). The quality of service desired by public transport users. *Transport Policy, 18*(1), 217-227. DOI: 10.1016/j.tranpol.2010.08.005

Dong, T., Jiao, L., Xu, G., Yang, L., & Liu, J. (2019). Towards sustainability? Analyzing changing urban form patterns in the United States, Europe, and China. *Science of the Total Environment, 671*, 632-643. DOI: 10.1016/j.scitotenv.2019.03.269

DoT Abu Dhabi. (2009). *Surface Transport Master Plan - a Vision for Connecting Abu Dhabi*. Abu Dhabi, United Arab Emirates

Echaniz, E., dell'Olio, L., & Ibeas, Á. (2018). Modelling perceived quality for urban public transport systems using weighted variables and random parameters. *Transport Policy, 67*, 31-39. DOI: 10.1016/j.tranpol.2017.05.006

Friman, M., & Fellesson, M. (2009). Service supply and customer satisfaction in public transportation: The quality paradox. *Journal of Public Transportation, 12*(4), 57-69. DOI: 10.5038/2375-0901.12.4.4

Fu, X.-m., Zhang, J.-h., & Chan, F. T. (2018). Determinants of loyalty to public transit: a model integrating Satisfaction-Loyalty Theory and Expectation-Confirmation Theory. *Transportation Research Part A: Policy and Practice, 113*, 476-490

Guirao, B., García-Pastor, A., & López-Lambas, M. E. (2016). The importance of service quality attributes in public transportation: Narrowing the gap between scientific research and practitioners' needs. *Transport Policy, 49*, 68-77. DOI: 10.1016/j.tranpol.2016.04.003

Hadiuzzman, M., Das, T., Hasnat, M. M., Hossain, S., & Rafee Musabbir, S. (2017). Structural equation modeling of user satisfaction of bus transit service quality based on stated preferences and latent variables. *Transportation Planning and Technology, 40*(3), 257-277

Hair, J. F., Sarstedt, M., Ringle, C. M., & Mena, J. A. (2012). An assessment of the use of partial least squares structural equation modeling in marketing research. *Journal of Academy of Marketing Science, 40*(3), 414-433

Hasan, U., Whyte, A., & Al Jassmi, H. (2018a). *Framework for Delivering an AV-based Mass Mobility Solution: Integrating Government-Consumer Actors and Life-cycle Analysis of Transportation Systems.* Paper presented at the 46th European Transport Conference, Dublin, Ireland

Hasan, U., Whyte, A., & Al Jassmi, H. (2018b). Life-cycle asset management in residential developments building on transport system critical attributes via a data-mining algorithm. *Buildings, 9*(1). DOI: 10.3390/buildings9010001

Hasan, U., Whyte, A., & Al Jassmi, H. (2019). a life-cycle decision-making framework to assess the need for autonomous mobility. *Transportation Research Procedia, 42*, 32-43. DOI: 10.1016/j.trpro.2019.12.004

Hasan, U., Whyte, A., & Al Jassmi, H. (2020). a review of the transformation of road transport systems: Are we ready for the next step in artificially intelligent sustainable transport? *Applied System Innovation, 3*(1), 1

Heinen, E., & Chatterjee, K. (2015). The same mode again? An exploration of mode choice variability in Great Britain using the National Travel Survey. *Transportation Research Part A: Policy and Practice, 78*, 266-282. DOI: 10.1016/j.tra.2015.05.015

Henseler, J., Hubona, G., & Ray, P. A. (2016). Using PLS path modeling in new technology research: Updated guidelines. *Industrial Management and Data Systems, 116*(1), 2-20. DOI: 10.1108/IMDS-09-2015-0382

Kamaruddin, R., Osman, I., & Pei, C. A. C. (2017). Customer expectations and its relationship towards public transport in Klang Valley. *Journal of ASIAN Behavioural Studies, 2*(4), 29-39

Kim, M. J., Lee, C.-K., & Bonn, M. (2017). Obtaining a better understanding about travel-related purchase intentions among senior users of mobile social network sites. *International Journal of Information Management, 37*(5), 484-496

Kroesen, M., Handy, S., & Chorus, C. (2017). Do attitudes cause behavior or vice versa? An alternative conceptualization of the attitude-behavior relationship in travel behavior modeling. *Transportation Research Part A: Policy and Practice, 101*, 190-202. DOI: 10.1016/j.tra.2017.05.013

Kwan, S. C., Sutan, R., & Hashim, J. H. (2018). Trip characteristics as the determinants of intention to shift to rail transport among private motor vehicle users in Kuala Lumpur, Malaysia. *Sustainable Cities and Society, 36*, 319-326. DOI: 10.1016/j.scs.2017.10.030

Lavery, T. A., Páez, A., & Kanaroglou, P. S. (2013). Driving out of choices: An investigation of transport modality in a university sample. *Transportation Research Part A: Policy and Practice, 57*, 37-46. DOI: 10.1016/j.tra.2013.09.010

Liu, Y., Sheng, H., Mundorf, N., Redding, C., & Ye, Y. (2017). Integrating norm activation model and theory of planned behavior to understand sustainable transport behavior: Evidence from China. *International journal of Environmental Research and Public Health, 14*(12), 1593

Loch, K. D., Straub, D. W., & Kamel, S. (2003). Diffusing the internet in the Arab world: The role of social norms and technological culturation. *IEEE Transactions on Engineering Management, 50*(1), 45-63

Lovelock, C., & Wirtz, J. (2016). *Services marketing: People, technology, strategy* (K. Samsudin Ed. 8th ed.). Singapore: World Scientific

Mezghani, M. (2006). North Africa and the Middle East: a promising region for public transport. *Public Transport International, 55*(2)

Mouwen, A. (2015). Drivers of customer satisfaction with public transport services. *Transportation Research Part A: Policy and Practice, 78*, 1-20. DOI: 10.1016/j.tra.2015.05.005

Mugion, R. G., Toni, M., Raharjo, H., Di Pietro, L., & Sebathu, S. P. (2018). Does the service quality of urban public transport enhance sustainable mobility? *Journal of Cleaner Production, 174*, 1566-1587. DOI: 10.1016/j.jclepro.2017.11.052

Qamhaieh, A., & Chakravarty, S. (2020). Drive-through cities: Cars, labor, and exaggerated automobilities in Abu Dhabi. *Mobilities, 15*(6), 792-809. DOI: 10.1080/17450101.2020.1822103

Rahman, S. M., Khondaker, A. N., Hasan, M. A., & Reza, I. (2017). Greenhouse gas emissions from road transportation in Saudi Arabia – a challenging frontier. *Renewable and Sustainable Energy Reviews, 69*, 812-821. DOI: 10.1016/j.rser.2016.11.047

Renne, J. L., Hamidi, S., & Ewing, R. (2016). Transit commuting, the network accessibility effect, and the built environment in station areas across the United States. *Research in Transportation Economics, 60*(Supplement C), 35-43. DOI: 10.1016/j.retrec.2017.02.003

Ringle, C. M., Wende, S., & Becker, J.-M. (2015). SmartPLS 3. In. Bönningstedt: SmartPLS

Sam, E. F., Hamidu, O., & Daniels, S. (2018). SERVQUAL analysis of public bus transport services in Kumasi metropolis, Ghana: Core user perspectives. *Case Studies on Transport Policy, 6*(1), 25-31

SBS Transit Ltd. (2019). Fares and Concessions. Retrieved from https://www.sbstransit.com.sg/Uploads/Whats%20New/Press%20Release%20Attachments/2019/Flyer%20-%20Bus%20and%20train%20fares%20from%2028%20Dec%202019.pdf

SCAD. (2014). *Statistical Yearbook of Abu Dhabi*. Abu Dhabi, United Arab Emirates: Statistics Centre - Abu Dhabi (SCAD) Retrieved from https://www.scad.ae/Release%20Documents/SYB-2014_V1.1_EN.pdf

Shen, W., Xiao, W., & Wang, X. (2016). Passenger satisfaction evaluation model for Urban rail transit: a structural equation modeling based on partial least squares. *Transport Policy, 46*, 20-31. DOI: 10.1016/j.tranpol.2015.10.006

Şimşekoğlu, Ö., Nordfjærn, T., & Rundmo, T. (2015). The role of attitudes, transport priorities, and car use habit for travel mode use and intentions to use public transportation in an urban Norwegian public. *Transport Policy, 42*, 113-120. DOI: 10.1016/j.tranpol.2015.05.019

Taylor, M. A. P., Young, W., Wigan, M. R., & Ogden, K. W. (1992). Designing a large-scale travel demand survey: New challenges and new opportunities. *Transportation Research Part A: Policy and Practice, 26*(3), 247-261. DOI: 10.1016/0965-8564(92)90035-6

Transport for NSW. (2021). Adult Fares. Retrieved from https://transportnsw.info/tickets-opal/opal/fares-payments/adult-fares

van Lierop, D., & El-Geneidy, A. (2016). Enjoying loyalty: The relationship between service quality, customer satisfaction, and behavioral intentions in public transit. *Research in Transportation Economics, 59*, 50-59. DOI: 10.1016/j.retrec.2016.04.001

Wu, I., & Pojani, D. (2016). Obstacles to the creation of successful bus rapid transit systems: The case of Bangkok. *Research in Transportation Economics, 60*(Supplement C), 44-53. DOI: 10.1016/j.retrec.2016.05.001

Yuda Bakti, I. G. M., Rakhmawati, T., Sumaedi, S., Widianti, T., Yarmen, M., & Astrini, N. J. (2020). Public transport users' WOM: an integration model of the theory of planned behavior, customer satisfaction theory, and personal norm theory. *Transportation Research Procedia, 48*, 3365-3379. DOI: 10.1016/j.trpro.2020.08.117