Service Quality Assessment of Paratransit in Dhaka City: A Structural Equation Approach

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Abstract: A reliable public transportation (PT) system is the core need of people in megacities of developing countries. Paratransit plays a vital role in megacities like Dhaka, where there is an insufficiency of the PT system. This study evaluates users' perception of various service features of paratransit modes in Dhaka city and find out the major attributes influencing the service quality (SQ) based on their experience of using the service. A questionnaire survey was conducted on 890 regular users of paratransit in ten locations in Dhaka city and the dataset was analyzed based on structural equation modeling (SEM) using forty SQ variables. The result shows that among forty variables, 'Level of personal safety' and 'Reliability of paratransit service' are the variables influencing the paratransit SQ significantly. The findings from this study are the most and the least important attributes which can be used by the policy-makers or city officials to understand the current situation in developing countries and improve the service quality of paratransit and draw more users attention.

Keywords: Paratransit service quality, users' perception, Structural Equation Model.

1. INTRODUCTION

Public transport (PT) plays a very important role to ensure sustainable transport policies by ensuring an alternative to traveling by personal transports. The service quality of PT has become one of the main priorities, as it helps users to choose between different transport modes by evaluating efficiency in their use of space and energy (Olio et al., 2018). In megacities of developing countries, PT are often insufficient to fulfill public needs as the services provided by them are quite unsatisfactory; as a result, people tend to use private vehicles frequently than public transport (Rahman et al., 2017). Through a better quality of transportation service, the guarantee of continuity of business can be assured, existing users may be secured, and new users may be attracted (Hensher and Brewer, 2000). The use of PT is declining because of the poor service quality of PT and private vehicle usage is increasing as it offers a greater movement flexibility (Anas et al., 2020).

Paratransit services provide flexible services with no fixed route or schedule. Paratransit services are mostly popular for their door to door services (Shimazaki and Rahman, 1996). In the Asian developing countries, the paratransit concept is different than the modern urban public transport system but in times paratransit serves as PT where there is an inadequacy of mass transit system (Tiglao et al., 2020). In many cities in developing countries, people have to depend on paratransit services because of its advantages like flexibility and affordability but still, the dependency is criticized the service lacks reliability in travel time and waiting time (Saddier et al., 2017). To identify the problems in paratransit service and suggest recommendations for passengers with limited mode choice option, the service quality assessment, user satisfaction, and service characteristics measurement has become the main concern in paratransit studies (Wongwiriya et al., 2020).

Service quality assessment is widely used measurement tool by the transportation researchers. Service quality is measured by comparing the delivered service with expectations. If customer expectations consistently matched with the delivered service quality then the service is considered to be reliable (Joewono and Kubota, 2007). In order to provide a suitable service for the users, the understanding of service quality is very beneficial for the operators and it also helps to better manage transit services (Hensher and Brewer, 2000). By measuring the quality of service, the most significant attributes can be found which influences people to accept or reject the service provided by the paratransit companies. Improving those attributes may result in increase in use of paratransit.

Dhaka, the capital city of Bangladesh has a population of over 16 million as of 2020 (Demographia, 2020) with one of the highest population density and growth rate. According to the strategic transport plan (STP 2005), it was found that only 200 buses are normally of good quality among 7,100 buses in Dhaka city for serving the people (Rahman et al., 2016). The Bangladesh Road Transport Authority (BRTA) record shows that the number of newly registered passenger car in the year of 2020 is 8799, while only 1679 buses registered in year 2020. Hence, the bus service cannot fulfill the expected demand of users'; as a result of high accessibility, mobility, time saving and safety purposes the paratransit is becoming more preferable than other service specially for middle to low income people who are highly dependent on paratransit at Dhaka city.

Figure 1 shows the structure of the running vehicles in Dhaka city (BRTA, 2020). Passenger cars and motorcycles are dominating the total vehicle fleet by 84%. Dhaka has a very poor number of buses relative to its residents who want to use them as a result paratransit has become an essential part of Dhaka cities transportation system. Though paratransit services are running by the private organizations only, the government regularly monitors the activities.

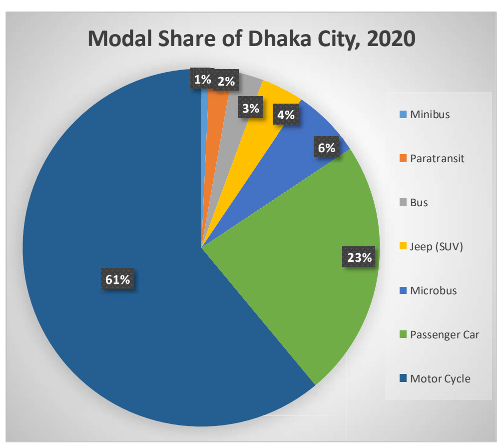

Figure 1. Dhaka city vehicle structure (BRTA, 2020)

This study aims at assessing user's perception towards paratransit service attributes influencing the SQ. To understand the user's perception and most influencing attributes of paratransit SQ several SEM models are developed. Over the years researchers have been assessed service quality of different transport modes by developing different models like ANOVA, MANOVA, SEM, Neural Network, discrete choice, ANSYS, SERVQUAL etc. In this study SEM is used as it is a multivariate statistical analysis technique where linear and cross-sectional statistical modeling is used to establish relationship between observed and latent variables. It is mostly a confirmatory, rather than exploratory modeling technique.

(i) (ii) (iii) (iv)

Figure 2. (i) CNG, (ii) Leguna, (iii) Auto Bike, (iv) Rikshaw

This study will represent the relationship between the overall paratransit service quality (SQ) and variables affecting the service quality. As an alternative to public transport the results of this study will help to identify user's demand so that the policymakers can take necessary decision to develop the paratransit service. This study focuses on some of the major points of paratransit service in Dhaka city.

2. LITERATURE REVIEW

Phun et al. (2017) emphasized that users' perception about the SQ and the degree of acceptance is solely responsible for the stability of paratransit services. In times paratransit has been used as the institutional transport system, sometimes used as the main mode of transportation and has been responsible for traffic problems like traffic jam, polluting the environment, and causing accidents due to its hasty and flexible movement in cities with widely spread paratransit service (Tiglao et al., 2019). In most developing countries the negligence towards the users' expectations has become the main reasons for poor SQ in paratransit services. To consistently satisfy maximum number of users, assessing users' perception of service quality has become very important (Das and Pandit, 2013).

A study by Phun et al. (2019) shows that due to the absence of proper direction, planning or guidance from government authorities, market mechanisms are driving the paratransit services to focus in places which are the centers of economic activity and near to the mass transit stations and other, including markets. Which indicates that with the proper monitoring and direction by the government, people can rely on paratransit because of the advantage with travel time and waiting time. Older adults has always been subjected to difficulty in travelling and always prefers the flexible movement service. With the increasing number of aged people many paratransit organizations are trying to gain stability with their services to meet the increased need of this particular service (Mo et al., 2020).

Paratransit services has neither any right of way, nor any fixed route or fixed schedule as they are operated without government subsidy (Joewono and Kubota, 2007; Tiglao et al., 2019). Though paratransit services are highly popular among people still they can't integrate into the broader PT service, as the bottom-up structure and influence of the industry owners itself holds it back. But with the flexibility and reliability often leads to compete against the formal transit mode (Joubert et al., 2020).

Tiglao et al. (2019) measured the SQ of public transport using Exploratory Factor Analysis in Metro Manila city and found that paratransit modes dominate the public transport system. In a study by Joewono et al. (2007) path analysis method was used in Indonesia to assess user perceptions of private paratransit operations. It was found that due to the paratransit dependency of a particular community, the future of the service is not really threatened. Sharma et al. (2020) determined the service quality of paratransit in India using RIDIT analysis and found that the attribute 'customer service' has the most influence on SQ.

SEM is used in this research because it focuses on latent constructs rather than on the variables used to measure these constructs. Manikandan & Vanniarajan (2016) measured service quality in bus services in Tamilnadu using Structural Equation Modeling (SEM) and found that the service quality factors like service planning and network have a major effect on passenger satisfaction and found that reliability influences the service planning. Zhou et al. (2016) measured pedestrians' perception using SEM in integrated transport hubs and found that to improve the SQ more attention has to be paid towards peak hours. Yaya et al. (2015) assessed SQ of PT in the city of Girona using SEM and found that driver's license has an influence on service quality. Mandhani et al. (2020) assessed the metro rail transit (MRT) SQ with SEM and the result showed that passenger ease has a positive impact and on the other hand comforts has no impact on overall SQ. In a study by Rahman et. al. (2017) SEM was used to determine the users' perception of paratransit service where 'availability of paratransit', 'speed of paratransit vehicle', 'travel time', 'ticketing system', and 'cleanliness of the vehicle' are found to be the most significant variables which influence the service quality of paratransit most.

The user's perception of service quality was assessed by Tiglao et al. (2020) in Metro Manila city. The SEM model showed that for a better paratransit service the understanding of PT service quality is much needed. Sumaedi et al. (2012) assessed the SQ of paratransit in Jakarta, Indonesia. Conceptualized relationship models were developed using SEM and the result showed that user's behavioral intention is significantly influenced by the quality of service provided.

3. METHODOLOGY

3.1 Experimental context

Nowadays surveys have become much popular among transport planners to find out the customer satisfaction, by which the most influential SQ attributes can be identified, and the service can be improved as well as the overall transportation problems can be minimized (Guirao et al., 2016). Researchers are always facing a challenge to find out the exact attributes of service quality which has direct impact on customer satisfaction. Attributes of different service features of paratransit are taken as the indicator of measuring the SQ. Developing these attributes is the first step to perform a purpose-built questionnaire survey.

3.2 Data Collection

To obtaining a large amount of information, questionnaire surveys (QS) provide a relatively quick, efficient and cheap way of collecting data from a large number of people. To know the actual condition of SQ service at Dhaka city, forty (40) important factors considering paratransit SQ, were asked to the users in this study. From, counseling with the policy makers (e.g., BRTA) ten (10) busiest locations were selected among more than 30 paratransit stations. Surveyors picked both public transport and paratransit passengers for data collection from these ten paratransit stations. The selected paratransit stations are Farmgate, Panthapath, Science Lab, Indira Road, Shyamoli, 60 feet, Mirpur 10, Shyamoli, Mohammadpur and Jigatola.

The questionnaire has two parts. In the first part socio demographic profiles of users were collected. The first part contains (Q1- Q9) on gender, age, education, occupation, monthly Income, main mode of travel, cars ownership, motorcycle ownership and monthly travel expenditure. The second part of the survey (Q10-Q49) was the main research questions addressed by different scores for each of the forty (40) variables. The 2nd part of the survey contains several fragments regarding service quality, users' safety, security, and existing condition of paratransit stand, reliability and flexibility. Questions were asked to the users' about SQ feature, ranging from excellent to very poor on a 5-point Likert rating scale. Questionnaire survey was carried out among one thousand (1000) respondents from which eight hundred and ninety (890) data were selected after filtering.

3.3 General information of respondents

The statistical analysis showed that 62% of the respondents were males and 38% were females. The age range was between 16 and 59, but 57% of the sample was between 20 and 29 and 18% was in between 30 to 39. 46% of them has an income below 10,000 (BDT), 42% was in between 10,000 to 30,000, 10% had in between 30,000 to 50,000, 2% were in between 50,000 to 70,000. 40% of the respondents had working job, 44% were student, 9% of them were businessman and 3 percent were housewives. The respondents were asked about their main mode of travel and it was found that 42% of them uses paratransit, 37% uses bus, 14% uses rickshaw, 4% uses Motorcycle and 3% uses car as their main mode of travel. Among them 94% didn't have a car and 91% didn't have motorcycle.

3.4 Preliminary statistics

All the variables of paratransit SQ were selected through focus group discussions, consultations of transportation experts and recommendations of previous researches. A set of forty (40) SQ attributes had been selected to perform the questioner survey. Table 1 shows the primary statistics of paratransit service attributes with mean ranges from 3.69 to 1.41 and standard deviations range from 1.60 to 0.73. The 'Mode to get paratransit' variable have the lowest mean value 1.41 and the 'Movement Flexibility (Inside)' has the highest value mean value 3.69.

Table 1. Primary statistics

Sl No.	SQ Variables	Mean	Standard deviation
1.	Fitness of paratransit	3.45	0.90
2.	Punctuality of transport	3.19	0.87
3.	Convenience of Service	3.10	0.90
4.	Level of personal safety	3.18	0.96
5.	Safety at paratransit stand	3.33	0.90
6.	Reliability of paratransit service	3.00	0.89
7.	Sitting arrangement	3.57	0.91
8.	Seat condition	3.65	0.84
9.	Lighting facility	3.47	0.79
10.	Noise level	3.63	0.85
11.	Physical condition	3.62	0.83
12.	Frequency of Travel	1.97	1.09
13.	Time for reach paratransit stand	2.20	1.15
14.	Trip purpose	2.09	1.32
15.	Frequency of service	2.91	0.89
16.	Movement flexibility on road	3.28	0.93
17.	Speed of paratransit	2.99	0.83
18.	Availability of information	3.67	0.91
19.	Paying fare / Ticketing system	3.62	0.99
20.	Transport Cost	2.90	0.77
21.	Reason of using paratransit	2.71	1.38
22.	Cleanliness of paratransit	3.64	0.86
23.	Paratransit's are always crowded	2.30	0.95
24.	Movement Flexibility (Inside)	3.69	0.84
25.	Comfort Level	3.59	0.82
26.	Cleanliness of paratransit stand	3.68	0.78
27.	Condition of paratransit stand	3.61	1.60
28.	Accessibility of paratransit stand	3.19	0.86
29.	Mode to get paratransit stand	1.41	0.73
30.	Security in paratransit stand	3.40	0.89
31.	Entry and Exit	3.57	0.84
32.	Security of peak period	3.51	0.87
33.	Driver safety (Driver skill)	3.62	0.97
34.	Behavior of driver	3.18	0.93
35.	Courtesy of Helpers/ Contactors	3.63	0.93
36.	Waiting time of the service	1.83	0.94
37.	Accessibility of paratransit	3.11	0.81
38.	Travel time (Office days)	3.60	0.95
39.	Travel time (Holidays)	2.75	0.92
40.	Rate of quality of paratransit service	3.34	0.78

3.5 Model Development

Structural equation modeling (SEM) technique was used to build conceptual models via Stata 14 software. SEM uses multivariate techniques to produce confirmatory results rather than exploratory if the model fits data (Byrne, 2011). The main reason of using the structural equation modeling technique is to estimate the latent (unobserved) variables formed in the study with the forty observed variables and asses if the structure is representative to actual data. SEM was selected for this study because of its authentic error measurement assessment for both independent and dependent variables, whereas most of the multivariate techniques lack the authentic error measurement (Byrne, 2011).

Structural Equation Models (SEMs)

The relationship between the variables is measured by developing several SEM models, the forty (40) variables are divided by endogenous or exogenous type and also introducing two latent variables. From the focus group discussion, it was found that 'Service features' and 'Physical appearance' are two most important attributes of paratransit SQ in the context of developing countries like Bangladesh. To measure the 'Service features' and 'Physical appearance' of paratransit two latent variables are formed as unobserved variables which will depend on the forty observed variables. To build conceptual models STATA 14 software was used in this study. Stata's data management and preparation is straightforward and replicable (Baldwin, 2019). Maximum likelihood estimation method was used in this study to analyze the complex SEM structures.

Hooper et al. (2008) introduced the principles to test the fitness of model. Three types of fitness guidelines were introduced which are absolute fit indices (RMSEA and SRMR), incremental fit indices (CFI) and parsimony fit indices (AIC). In a study by Steiger (1990) it was shown that the RMSEA value of a model lower than 0.05 or 0.10 is respectively taken as 'very good' or 'good and a CFI value 1.0 means a good fit. Vandenberg and Lance, (2000) showed that the SRMR value of any model below 0.10 is considered as a good fit. Among different models the lowest AIC reading indicates the best model. To find the best fit model for paratransit SQ, the dataset was tested in three different models. The best fit model will represent the users' perception about paratransit SQ.

Model 1 (M1)

M1 is developed with thirty-four endogenous variables and five exogenous variables. There is a latent variable 'Service features' ($\eta 1$) in this model which is calibrated by five endogenous variables such as 'Punctuality of transport', 'Convenience of service', 'Level of personal safety', 'Safety at paratransit stand' and 'Reliability of paratransit service'. The endogenous variable 'Fitness of paratransit' is dependent on the exogenous variables 'Sitting arrangement', 'Seat condition', 'Lighting facility', 'Noise level' and 'Physical condition'. Equation (1) extracted from M1 can be written as follow:

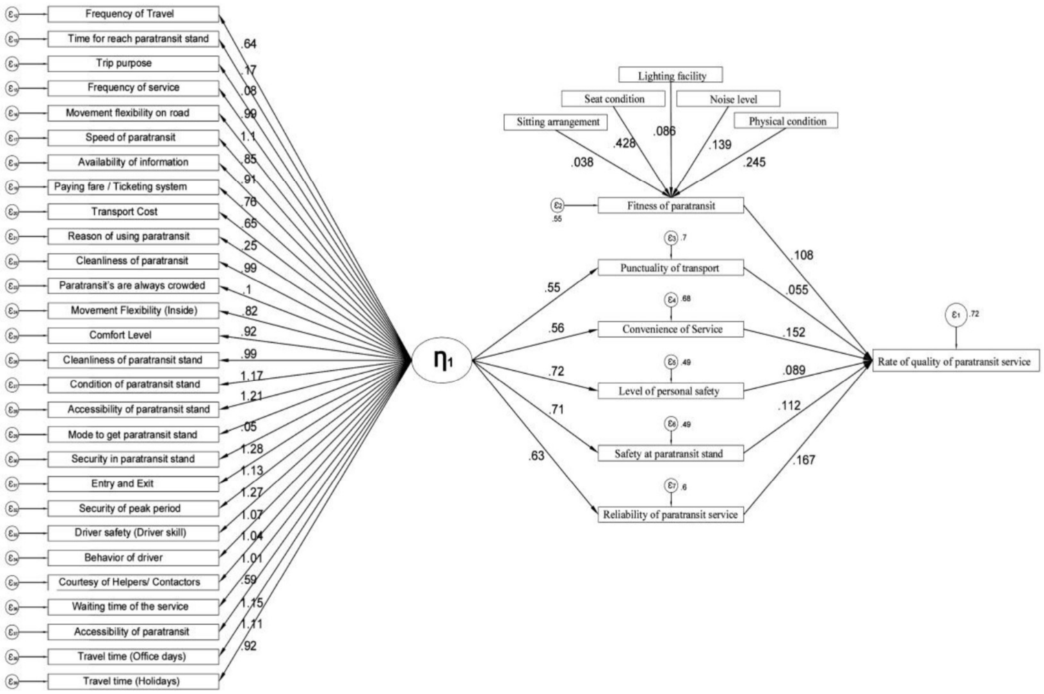

Figure 3. Model 1 (M1)

$Z = \lambda 0 + \lambda Y + \delta$ ……......................... (1)

Where, Y represents 'Fitness of paratransit' variable in equation (2) and 'Punctuality of transport', 'Convenience of Service', 'Level of personal safety', 'Safety at paratransit stand', 'Reliability of paratransit service' in equation (3).

$Y = \Gamma x + \varepsilon$ ………....................................(2)

$Y = \alpha\eta + \varepsilon$ ………....................................(3)

In equation (4) η represents the latent variable 'Service features'

$\eta = (y - \rho)/\gamma$ ....(4)

Explanation of M1

M1 introduces a latent variable 'Service features, (η1)' which represents the overall performance standard of the vehicle. 'Punctuality of transport', 'Convenience of service', 'Level of personal safety', 'Safety at paratransit stand' and 'Reliability of paratransit service' are the SQ variables that depends on the latent variable η1. 'Service features' calculated from the twenty-eight endogenous variables that addresses the performance standards of paratransit.

The result of M1 shows that 'Security in paratransit stand' is the main variable that influences SQ positively. But it was found that the variable 'Reliability' doesn't influence the SQ significantly, which does not comply with reality as reliability is important for most passengers desiring less 'Travel time'. SRMR value of M1 is 0.151 (table 3) and CFI value is 0.641 (table 3).

Model 2 (M2):

The second model M2 is constructed with only endogenous and latent variables. The variables

‘Sitting arrangement’, ‘Seat condition’, ‘Lighting facility’, ‘Noise level’ and ‘Physical condition’ is used to estimate the second latent variable ‘Physical appearance, ($\eta 2$)’. The latent variable ‘Service features’ ($\eta 1$) is estimated from the other endogenous variables.
Equation (5) extracted from M2 can be written as follow:

$$Z = \lambda 0 + \mu\eta + \delta \ldots\ldots\ldots\ldots (5)$$

In equation (6) η represents the latent variables ‘Service features’ and ‘Physical appearance’ estimated from the endogenous variables shown in Figure 4.

$$\eta = (y - \rho)/\gamma \ldots\ldots\ldots\ldots (6)$$

Explanation of M2

Due to the unfitness of model-1, M2 is developed. A new latent variable is introduced in this model which is ‘Physical appearance’. The latent variable $\eta 2$ (Physical appearance) represents the physical performance standard of the vehicle like ‘Sitting arrangement’, ‘Seat condition’, ‘Lighting facility’, ‘Noise level’ and ‘Physical condition’ and the latent variable $\eta 1$ (Service features) represents the overall performance standard of paratransit, which is represented by the other thirty-four endogenous variables

M2 results do not comply with the actual scenario of Dhaka city because the result shows ‘Reliability’ as an insignificant variable. SRMR and CFI values are 0.14 and 0.663 (table 3) respectively.

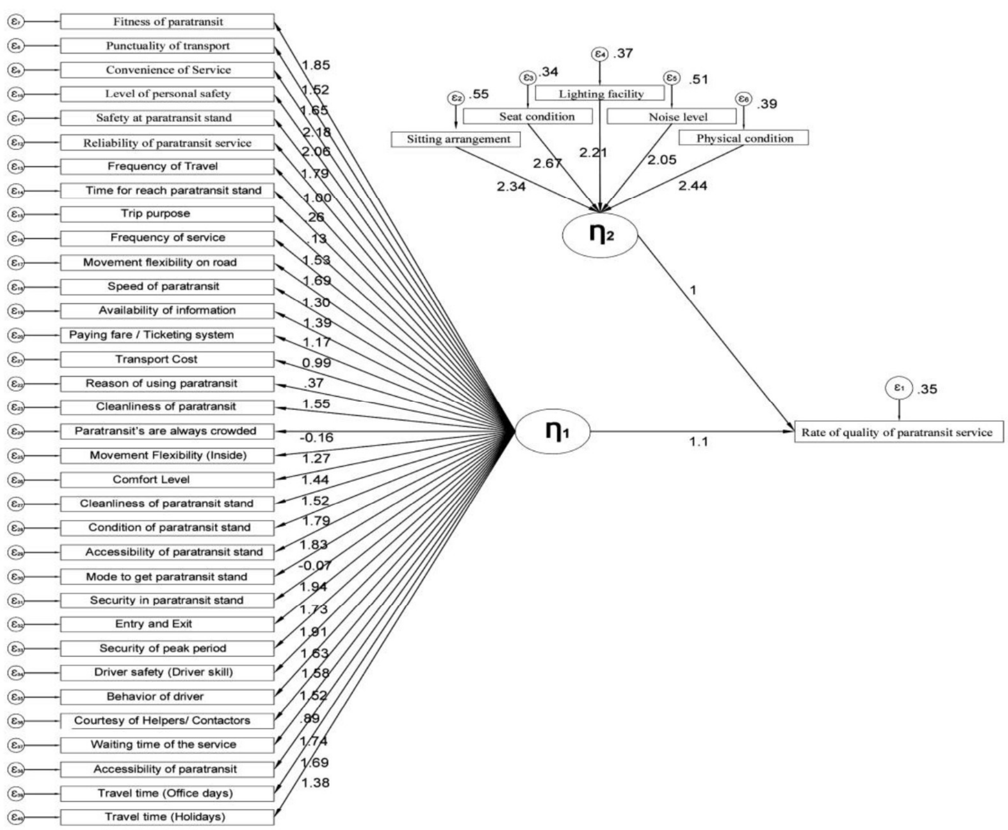

Figure 4. Model 2 (M2)

Model 3 (M3):

M3 is developed with two latent variables and forty endogenous variables. The two latent variables in this model are η1 (Service features) and η2 (Physical appearance). Equation (7) can be extracted from M2

$Z = \lambda 0 + \lambda Y + \delta$ ……......................... (7)

Where, Y represents ‘Fitness of paratransit’, ‘Punctuality of transport’, ‘Convenience of service’, ‘Level of personal safety’, ‘Safety at paratransit stand’, ‘Reliability of paratransit service’ in equation (7).

In equation (8) and (9) η represents the latent variables ‘Service features’ and ‘Physical appearance’ respectively.

$\eta = (y - \rho)/\gamma$ ....(8)

$\eta = (y - \varepsilon)/\beta$ ....(9)

Explanation of M3

To minimize the limitation of model M1 and M2, Model M3 is developed where two latent variables were introduced which represent the overall performance standard of paratransit and the physical performance standard of paratransit like ‘Sitting arrangement’, ‘Seat condition’, ‘Lighting facility’, ‘Noise level’ and ‘Physical condition’. The endogenous variables ‘Fitness of paratransit’, ‘Punctuality of transport’, ‘Convenience of service’, ‘Level of personal safety’, ‘Safety at paratransit stand’, ‘Reliability of paratransit service’ depend on both the latent variables η1 and η2. The latent variable ‘Physical appearance, (η2)’ is calculated from endogenous variables ‘Sitting arrangement’, ‘Seat condition’, ‘Lighting facility’, ‘Noise level’ and ‘Physical condition’ and ‘Service features, (η1)’ is calculated from endogenous variables shown in Figure 5.

Result shows that ‘Level of personal safety’, ‘Safety at paratransit stand’ and ‘Reliability of paratransit service’ are the three most significant variables that has direct impact on the service quality of paratransit, which comply with the actual situation of Dhaka city as most of the users feel a lack of personal safety due to the gathering at paratransit stand at peak hour on office days. However, M1 and M2 results show less influence of ‘Reliability’ on paratransit SQ but M3 shows that ‘Reliability of paratransit service’ has significant impact on the paratransit SQ.

4. EMPIRICAL RESULTS

Among the three models, M3 is the best fit and match the real scenario prevailing in Dhaka city. Result shows that among the variables, the most significant are ‘Level of personal safety’, ‘Reliability of paratransit service’ and ‘Safety at paratransit stand’ where ‘Level of personal safety’ has the highest coefficient value of 2.77 (Table 2). It can be said that users are really care about personal safety and security, and travel time which influences the ‘Level of personal safety’, ‘Safety at paratransit stand’ and ‘Reliability of paratransit service’ of paratransit service. In a previous study by de Oña et al. (2013) it was found ‘Frequency’ to be the most significant variable for paratransit SQ. In another study, Joewono and Kubota (2007) showed that ‘Comfort’ is the most influencing paratransit attribute for users in Bandung, Indonesia.

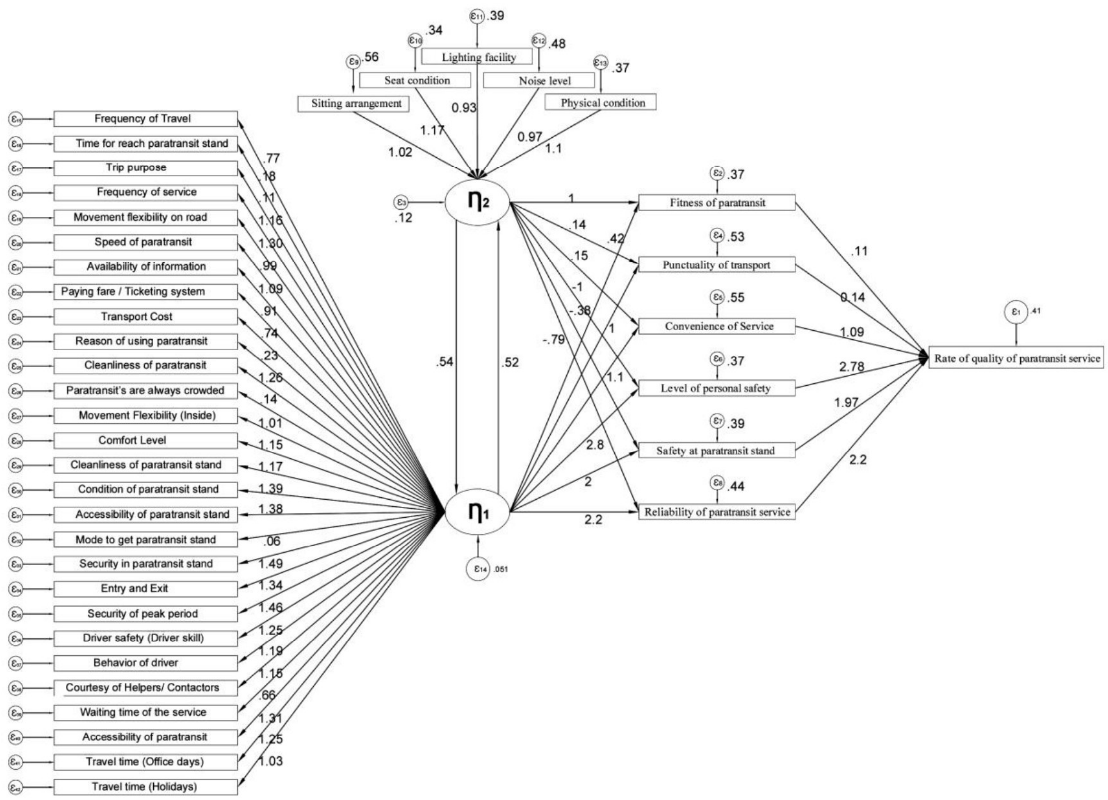

Figure 5. Model 3 (M3)

Table 2. Estimated coefficient and P values of developed SE models

Sl No.	SQ variables	M1	M2	M3
1.	Fitness of paratransit	0.108 (0.000)	1.854 (0.000)	0.108 (0.000)
2.	Punctuality of transport	0.055 (0.049)	1.523 (0.000)	0.142 (0.259)
3.	Convenience of Service	0.152 (0.000)	1.650 (0.000)	1.093 (0.000)
4.	Level of personal safety	0.089 (0.003)	2.178 (0.000)	2.775 (0.000)
5.	Safety at paratransit stand	0.112 (0.000)	2.055 (0.000)	1.969 (0.000)
6.	Reliability of paratransit service	0.167 (0.000)	1.787 (0.000)	2.197 (0.000)
7.	Sitting arrangement	0.038 (0.194)	2.344 (0.000)	1.015 (0.000)
8.	Seat condition	0.428 (0.000)	2.666 (0.000)	1.166 (0.000)
9.	Lighting facility	0.086 (0.013)	2.205 (0.000)	0.925 (0.000)
10.	Noise level	0.139 (0.000)	2.052 (0.000)	0.963 (0.000)
11.	Physical condition	0.245 (0.000)	2.443 (0.000)	1.097 (0.000)
12.	Frequency of travel	0.638 (0.000)	1.00 (000)	0.771 (0.000)
13.	Time for reach paratransit stand	0.176 (0.036)	0.260 (0.045)	0.183 (0.068)
14.	Trip purpose	0.080 (0.402)	0.130 (0.371)	0.106 (0.343)
15.	Frequency of service	0.999 (0.000)	1.526 (0.000)	1.155 (0.000)
16.	Movement flexibility on road	1.098 (0.000)	1.688 (0.000)	1.302 (0.000)
17.	Speed of paratransit	0.845 (0.000)	1.301 (0.000)	0.994 (0.000)
18.	Availability of information	0.905 (0.000)	1.386 (0.000)	1.085 (0.000)
19.	Paying fare/Ticketing system	0.756 (0.000)	1.167 (0.000)	0.910 (0.000)
20.	Transport cost	0.647 (0.000)	0.991 (0.000)	0.736 (0.000)
21.	Reason of using paratransit	0.247 (0.015)	0.370 (0.020)	0.234 (0.054)
22.	Cleanliness of paratransit	0.988 (0.000)	1.546 (0.000)	1.258 (0.000)
23.	Paratransits are always crowded	0.096 (0.166)	-0.1587 (0.140)	0.138 (0.097)

24.	Movement Flexibility (Inside)	0.816 (0.000)	1.268 (0.000)	1.006 (0.000)
25.	Comfort Level	0.918 (0.000)	1.443 (0.000)	1.153 (0.000)
26.	Cleanliness of paratransits	0.991 (0.000)	1.516 (0.000)	1.169 (0.000)
27.	Condition of paratransit stand	1.166 (0.000)	1.787 (0.000)	1.393 (0.000)
28.	Accessibility of paratransit stand	1.206 (0.000)	1.829 (0.000))	1.379 (0.000)
29.	Mode to get paratransit stand	0.049 (0.360)	-0.0726 (0.375)	0.055 (0.377)
30.	Security in paratransit stand	1.277 (0.000)	1.939 (0.000)	1.486 (0.000)
31.	Entry and Exit	1.131 (0.000)	1.727 (0.000)	1.341 (0.000)
32.	Security of peak period	1.267 (0.000)	1.909 (0.000)	1.459 (0.000)
33.	Driver safety /Driver skill	1.069 (0.000)	1.626 (0.000)	1.245 (0.000)
34.	Behavior of driver	1.037 (0.000)	1.577 (0.000)	1.192 (0.000)
35.	Courtesy of Helper/Contactors	1.005 (0.000)	1.524 (0.000)	1.147 (0.000)
36.	Waiting time of the service	0.593 (0.000)	0.894 (0.000)	0.655 (0.000)
37.	Accessibility of paratransit	1.147 (0.000)	1.736 (0.000)	1.310 (0.000)
38.	Travel time (Office days)	1.110 (0.000)	1.668 (0.000)	1.246 (0.000)
39.	Travel time (Holidays)	0.916 (0.000)	1.381 (0.000)	1.034 (0.000)
40.	Service features	N/A	N/A	0.539 (0.990)
41.	Physical appearance	N/A	N/A	0.518 (0.975)

Table 3. Fitness of different models

Fit indices	M1	M2	M3	Ideal Range
Absolute fit indices Root Mean Squared Error of Approximation (RMSEA)	0.083	0.083	0.077	0.05-0.10
Standardized Root Mean Square Residual (SRMR)	0.151	0.140	0.065	< 0.10
Incremental fit index Comparative Fit Index (CFI)	0.641	0.663	0.717	1.00
Parsimony fit index Akaike's Information Criterion (AIC)	85684.49	85794.95	85086.07	

Among different developed SE models, the fitness of M3 is satisfactory (CFI=0.717, RMSEA=0.077, SRMR=0.065; table 4). M3 has the lowest AIC value of 85086.07 (table 4) which makes the M3 an ideal model to represent the attributes of paratransit SQ. Model-3 results shows that the latent variable 'Service Features' gets the greatest weightage than 'Physical Appearance' which indicates that people are more interested about service features of paratransit.

From Model-3 (M3) the ten most significant attributes are found to be 'Level of personal safety', 'Reliability of paratransit service', 'Safety at paratransit stand', 'Security in paratransit stand', 'Security of peak period', 'Condition of paratransit stand', 'Accessibility of paratransit stand', 'Entry and Exit', 'Accessibility of paratransit' and 'Movement flexibility on road'. These variable influences the paratransit service quality of Dhaka city the most. Among them 'Level of personal safety', 'Reliability of paratransit service' and 'Safety at paratransit stand' has the highest number of co-efficient which mean these three service quality attributes are the reason satisfaction of paratransit.

Consistency of the SEM results was measured by Cronbach Alpha. Cronbach alpha is a most widely used measure to assess the internal consistency of a test or scale. The acceptable values of the Cronbach's alpha ranges from 0.70 to 0.95 (Nunnally, 1994; Bland and Altman, 1997; DeVellis, 2016). For this analysis the value of Cronbach's alpha is found 0.9135, which is in between 0.70 to 0.95. So, it can be said that the SEM results are consistent enough.

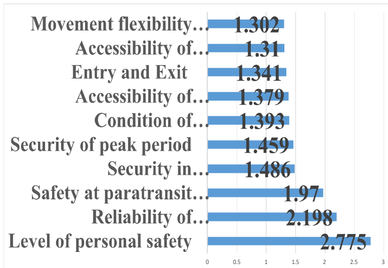

Figure 6. Influence of variables on paratransit SQ

Model-3 shows that the variable 'Level of personal safety' the highest influence over the service quality of paratransit. Level of personal safety represents the lack of personal security while traveling through paratransit. In Dhaka city while traveling by the most used paratransit like 'Leguna' people don't have much safety due to the crowded vehicle. The entry and exit systems are too risky for people of any age. Paratransit mostly runs through the narrow routes where bus service can't be provided. Paratransit drivers runs the vehicles through these narrow streets which increases the risk of safety. With the lack of proper life security people travels in paratransit because of its availability. With proper safety paratransit service providers can attract more users.

Reliability of paratransit service was found to be second most significant variable of service quality. People started using paratransit service as the reliability of traditional public transport was too poor because. The travel time in paratransit must be lower than public transport so that people can move from one place to another with less time. The travel time of office days are more influencing than the travel time of holidays. With the availability of paratransit at peak hour and less travel time paratransit can be very efficient travel mode of Dhaka city.

Dearth of an adequate safe paratransit stand is one of the biggest disadvantages of paratransit service. People often feel unsafe at a crowded stand. Due to absence of formal ticketing system users often feel irritated. With the lack of proper stand, unavailability of proper ticketing system and less availability of vehicles at peak hour people feel unreliable to use the service. A proper stand with ticketing system can help build a safe environment around the paratransit stand which in terms influences the service quality.

5. CONCLUSION

This study evaluates users' perception of various service features of paratransit modes in Dhaka city and find out the major attributes influencing the service quality (SQ) based on their experience of using the service. SEM is a multivariate statistical analysis technique where linear and cross-sectional statistical modeling is used to establish relationship between observed and latent variables. It is mostly a confirmatory, rather than exploratory modeling technique. Several models are developed using SEM to identify the most influencing attributes of paratransit SQ. Among three models M3 is selected to be the best fit model as M3 has the best goodness-of-fit indices with CFI value to be 0.717, RMSEA value to be 0.077, SRMR value to be 0.065 and the AIC value for M3 is 85086.07 (table 4).

The results show that ‘Service features’ has more influence on SQ than ‘Physical appearance’. ‘Level of personal safety’, ‘Reliability of paratransit service’ and ‘Safety at paratransit stand’ are the most influencing SQ attributes. The results also showed that during the office days users are not convinced with ‘travel time’. The finding also reveals that the SQ attribute ‘Paratransits are always crowded’ is not good enough for paratransit users as it affects the ‘Level of personal safety’ & ‘Safety at paratransit stand’ because people feel a lack of personal safety due to the gathering at paratransit stand at peak hour on office days.

The study reveals that the paratransit users are less concerned with the ‘Fitness of vehicle’. Though the result may appear insupportable in some ways but by observing the congestion of Dhaka city this result can comply with real life scenario, where the main concern of users’ is less travel time. It shows that if the travel time is less, the users will choose paratransit more, over other public transportation ignoring the ‘Fitness of vehicle’. It is expected that the Structural Equation Model would be able to reveal the variables influencing transit customer satisfaction to enhance the overall performance of the paratransit. The findings from this study are the most and the least important attributes which can be used by the policymakers or city officials to comprehend the current situation in developing countries like Bangladesh. The results can be used to improve the service quality of paratransit, draw more user’s attention, and sustain the current users.

The number of service attributes considered for this research may be extended. The number of locations could be more. For a better comprehension of result more survey locations may be considered. Number of respondents may also increase in future.

6. REFERENCES

Rahman, F., Das, T., Hadiuzzaman, M., Hossain, S. (2016) Perceived service quality of paratransit in developing countries: A structural equation approach. *Transportation Research Part A: Policy and Practice, Volume 93, Pages 23-38.*

Hensher, D., Brewer, A. (2000) Transport: an economics and management perspective. OUP Catalogue.

Anas, R., Hasibuan, A.K., Dharmowijoyo, D.B.E., Sembiring, I.S., Dewi, R.A. (2020) Evaluation of paratransit performance as public transport in Medan City. In IOP Conference Series: Materials Science and Engineering (Vol. 801, No. 1, p. 012012). IOP Publishing.

Demographia (2020). World Urban Areas. 16th Annual Edition - 2020. Retrieved from: http://www.demographia.com/db-worldua.pdf

Rahman, F., Chowdhury, T. D., Haque, T., Rahman, R., Islam, A. (2017) Identifying existing Bus service condition and analyzing customer satisfaction of Bus service in Dhaka city. *Journal of Transportation Technologies, 7(2), 107-122.*

Shimazaki, T., Rahman, M. (1996). Physical characteristics of paratransit in developing countries of Asia. *Journal of advanced transportation, 30(2), 5-24.*

Rahman, F., Haque, M.F., Ehsan, M.T., Rahman, S.M.M., Hadiuzzaman, M. (2017) Determination of user’s perception of paratransit service quality in Dhaka city based on user’s perception. *Inter Journal of Education and applied science, 7, 19-24.*

Tiglao, N.C.C., Veyra, J.M.D., Tolentino, N.J.Y., Tacderas, M.A.Y. (2020) The perception of service quality among paratransit users in Metro Manila using structural equations modelling (SEM) approach. *Research in Transportation Economics, Volume 83, 100955.*

Saddier, S., Patterson, Z., Johnson, A., Wiseman, N. (2017) Fickle or Flexible?: Assessing Paratransit Reliability with Smartphones in Accra, Ghana. *Journal of the Transportation Research Board, Volume: 2650, issue: 1, page(s): 9-17.*

Wongwiriya, P., Nakamura, F., Tanakac, S., Ariyoshid, R., Miura S. (2020) The Role of Paratransit to Support Sustainable Transportation: Case Study of Khon Kaen City. *Thailand. Transportation Research Procedia, Volume 48, (2020), P 2656–2670.*

Joewono, T.B., Kubota, H. (2007) User Perceptions of Private Paratransit Operation in Indonesia. *Journal of Public Transportation, 10 (4): 99-118.*

Phun, V.K., Kato, H., Yai, T. (2017) Characteristics and Perceptions of Paratransit Users in Phnom Penh. *Journal of the Eastern Asia Society for Transportation Studies, Vol.12, 2017, 2215.*

Pandit, D., Das, S. (2013) A Framework for Determining Commuter Preference Along A Proposed Bus Rapid Transit Corridor. *Procedia - Social and Behavioral Sciences 104:894–903.*

Tiglao, N.C.C., Veyra, J.M.D., Tolentino, N.J.Y. (2019) The Quality of Service Perception among Public Transport Users in Metro Manila Considering Dominance of Paratransit Modes. *No. 1303. EasyChair, 2019.*

Phun, V.K., Kato, H., Chalermpong, S. (2019) Paratransit as a connective mode for mass transit systems in Asian developing cities: Case of Bangkok in the era of ride-hailing services. *Transport Policy, Volume 75, Pages 27-35.*

Mo, D.Y., Lam, H.Y., Xu, W., Ho, G.T.S. (2020) Design of Flexible Vehicle Scheduling Systems for Sustainable Paratransit Services. *Sustainability 2020, 12, 5594.*

Joubert, J.W., Venter C.J. (2020) Behavioural response of paratransit to formal public transport in hybrid systems. *Procedia Computer Science Volume 170, 2020, Pages 696-701.*

Sharma, D., Pandit, D., Bose, T. (2020) Determination of service quality attributes based on user perception for paratransit services in developing country like India. *Transportation Research Procedia 48 (2020) 3577–3594.*

Zhou, J., Guo, Y., Dong, S., Zhao, Li., Yang, R. (2016) Structural Equation Modeling for Pedestrians' Perception in Integrated Transport Hubs. *Procedia Engineering 137 (2016) 817 – 826.*

Manikandan, B., Vanniarajan, T. (2016) Service Quality in Bus Services: An Empirical Study in Tamilnadu. *Shanlax International Journal of Management, Volume 4, Issue 2 October 2016, ISSN: 2321 – 4643.*

Yaya, L.H.P., Fortià, M.F.F., Canals, C.S., Marimon, F. (2015) Service quality assessment of public transport and the implication role of demographic characteristics. *Public Transport volume 7, pages 409–428(2015).*

Mandhani, J., Nayak, J.K., Parida, M. (2020) Interrelationships among service quality factors of Metro Rail Transit System: An integrated Bayesian networks and PLS-SEM approach. *Transportation Research Part A: Policy and Practice, Volume 140, October 2020, Pages 320-336.*

Sumaedi, S., Bakti, I.G.M.Y., Yarmen, M. (2012) The Empirical Study of Public Transport Passengers' Behavioral Intentions: The Roles of Service Quality, Perceived Sacrifice, Perceived Value, And Satisfaction (Case Study: Paratransit Passengers in Jakarta, Indonesia). *International Journal for Traffic and Transport Engineering, 2012, 2(1): 83 – 97.*

Guirao, B., Pastor, A.G., Lambas, M.E.L. (2016) The importance of service quality attributes in public transportation: Narrowing the gap between scientific research and practitioners' needs. *Transport Policy, Volume 49, July 2016, Pages 68-77.*

Steiger, J.H. (1990) Structural model evaluation and modification: an interval estimation approach. *Multivariate behavioral research, 25(2), 173-180.*

Hooper, D., Coughlan, J., Mullen, M.R., (2008) Structural equation modelling: guidelines for determining model fit. *Electron. J. Bus. Res. Meth. 6 (1), 53–60.*

Vandenberg, R.J, Lance, C.E. (2000) A Review and Synthesis of the Measurement Invariance Literature: Suggestions, Practices, and Recommendations for Organizational Research. *Organizational Research Methods, Vol. 3 No. 1, January 2000, 4-70.*

Dell´Olio, L., Ibeas, A., de Ona, J., de Ona, R. (2017) Public transportation quality of service: Factors, models, and applications. Elsevier. *Public Transportation Quality of Service. Factors, Models, and Applications 2018, Pages 7-32.*

Baldwin, S. A. (2019). Psychological statistics and psychometrics using Stata. *College Station, TX: Stata Press.*

Nunnally, J. C. (1994). Psychometric theory 3E. *Tata McGraw-hill education.*

Bland, J. M., & Altman, D. G. (1997). Statistics notes: Cronbach's alpha. *Bmj, 314(7080), 572.*

DeVellis, R. F. (2016). Scale development: Theory and applications (Vol. 26). *Sage publications.*

Byrne, B. M. (2011). Structural equation modeling with Mplus: Basic concepts, applications, and programming. *New York, NY: Routledge.*