ASSESSMENT OF THE PERCEPTION OF COMMUTERS TOWARDS SERVICE QUALITY OF MASS RAPID TRANSIT IN DHAKA CITY, BANGLADESH

Siam Junaed[1], Nazmus Sakib*[2], Tofayel Ahmed Tapu[3], Razesh Kanti Sarkar[4]

[1] *Graduate Research Assistant, University of Louisiana at Lafayette, USA, e-mail: siamjunaed01.ce@gmail.com*
[2] *Former Undergraduate Student, Ahsanullah University of Science and Technology, Bangladesh, e-mail: nazmussakib.austce@gmail.com*
[3] *Lecturer, Uttara University, Bangladesh, e-mail: tofayelahmedtapu@uttarauniversity.edu.bd*
[4] *Lecturer, Uttara University, Bangladesh, e-mail: rksarkar@uttarauniversity.edu.bd*

***Corresponding Author**

ABSTRACT

Dhaka Mass Rapid Transit (MRT) system is the first-ever rapid transit system in Bangladesh, implemented with the aim of mitigating the acute traffic congestion in Dhaka City by providing a dependable transportation alternative to personal automobiles. In order to assess the performance and service quality of this newly launched metro system, a survey utilizing a questionnaire format was employed, wherein data was collected via both online and in-person interactions. This questionnaire employed a total of Fifteen independent variables along with one dependent and seven demographic attributes. The dataset was subjected to analysis through the utilization of Ordinal Logistic Regression (OLR). The study provides significant perspectives on the attributes that impact the service quality of the Dhaka Mass Rapid Transit (MRT) system. OLR elucidate that among the fifteen factors, nine factors are positively significant on Overall Service Quality (OSQ) of Dhaka MRT namely Train Availability, Crowdedness in Train, Crowdedness in Station, Ticket Fare, Cleanliness in Train, Cleanliness in Station, Washroom Facilities in Station, Courtesy of The Employees, Co-Passengers' Behavior. The OLR model results also depict that Co-Passengers Behavior is the most important and Ticket Fare is the least important attribute among the significant variables which affect the OSQ. The findings of this research provide valuable insight for evidence-driven decision-making in the realm of urban transport planning and policy development. By prioritizing the improvement of service quality within the Dhaka Mass Rapid Transit (MRT) system, it is feasible to establish a more sustainable, effective, and user-oriented public transportation network in Dhaka City, thereby enhancing the general standard of living for its inhabitants.

Keywords: *Dhaka MRT, Service Quality, Commuters Perception, Ordinal Logistic Regression*

1. INTRODUCTION

The ever-increasing urban population in the last decades has forced the development and advancement of efficient public transport systems. Dhaka, the capital of Bangladesh is one of the most crowded cities in the world, faces problems such as overcrowding, poor road networks, noise and air pollution (Junaed et al., 2022; Mahmud et al., 2012; Paul et al., 2022; RİYAD et al., 2020). Because of the unregulated growth of private vehicles, inefficient traffic signaling system, inadequate road infrastructure, and drivers' propensity to not follow regulations, traffic congestion becomes a major problem in this urban landscape which exerts a tremendous impact on the daily routine of inhabitants (Mahmud et al., 2012). With the aim to address the rising level of traffic congestion in the city, Mass Rapid Transit (MRT) has become one of the major initiatives that are currently being implemented in order to improve the living conditions of people in Dhaka (Alam, M.S., 2010). The MRT is expected to support the government in reducing traffic congestion, and environmental pollution along with revitalizing areas along the MRT route while enhancing regional and national economies (Annual Report MRT Jakarta, 2013).

The Dhaka Metro Rail (DMR) was constructed as a part of a 20-year strategic plan to reduce the traffic congestion of Dhaka city. A total of six rail lines are planned for the total network, where Line 6 (Uttara to Kamalapur), which is 20.1 km long with 16 stations was recently opened for public use (Akhter, 2022). During this study timeline, the first line to operate is the Uttara to Agargaon Section, with 11.73 km and can carry up to 60,000 passengers per hour (Saleh et al., 2023). However, the success and efficacy of any Mass Rapid Transit depends not only on its technical condition, and operability but also on how the users feel during their everyday traveling (Le-Klähn et al., 2014). Commuter satisfaction is a complex concept incorporating several elements of service quality such as reliability, availability, safety, comfort, and convenience. Policymakers, urban planners, as well as, transportation authorities must understand the dynamics of commuter perceptions toward the service quality of MRT because this process will significantly lead to the long-term sustainability of public transport in Dhaka (Andaleeb et al., 2007).

This paper looks at the influencing factors that could affect the service quality of the mass rapid transit (MRT) in Dhaka City, Bangladesh. Examining the determinants of commuters' satisfaction and dissatisfaction together with identifying the avenues for improvement should form the nucleus from which informed strategic interventions and policy initiatives will result from this research exercise. This study aims to assess commuters' feedback regarding urban transportation planning for the benefit of promoting a more sustainable, effective, and passenger-oriented MRT project in Dhaka.

2. LITERATURE REVIEW

Extensive research into assessing the significance of customer satisfaction towards metro rail service's qualities attributes are-very crucial, particularly at both international and national levels. Hence, there is a need to establish the research gaps in this study. The research conducted by Doi & Aoki. (1999) reveal that congestion experienced at stations, inappropriate links or connection patterns and charges contribute to customers' dissatisfaction with the metro service. In assessing the degree of customer satisfaction with Istanbul, Turkey's rail system, Celik et al. (2014) found that the main areas in need of improvement were train density and crowdedness, air conditioning, noise and vibration levels, and phone offerings. Putra et al. (2014) investigated the level of satisfaction that public transport offered users based on their perceptions. The research discovered that there was room for improvement regarding comfort, flexibility, and reliability in the transportation sector of Indonesia. Saw et al. examined passenger satisfaction with the subway system, facilities and services of the Tyne and Wear Metro in the United Kingdom. It was found that, from the user's perspective, ticket prices, overall station cleanliness, station conditions and train cleanliness all performed poorly (Saw et al., 2020). Choocharukul et al. (2013) conducted a survey in Bangkok regarding the quality assessment of metro service using Factor Analysis in SPSS Structural Equation Modelling (SEM). From 661 sample answers, it was found that travel convenience, ticket fare, service and information, cleanliness and

safety, transit facilities and access to stations play crucial factors in the service quality of the metro project. Dahlan et al. (2019) used the Chi-squared Test on 516 samples and discovered that significant factors affecting the service quality of metro services are reliability and security. De Oña et al. (2015) conducted an experiment on 3211 people in Sevilla, Spain and analysed the survey result using Structural equation modelling (SEM). In this study, the influencing factors are identified as tangible service equipment, accessibility, availability of the service, information, security, customer service, individual space, and environmental pollution. Sadhukhan et al. (2015) looked at some characteristics of some transfer stations in and around Kolkata in India's metro stations. It was noted that people valued visual communication and the environment on foot more than travelling by subway. The examination of factors influencing service quality is of paramount significance for the inaugural mega project, the Mass Rapid Transit (MRT), in Bangladesh. This study aims to systematically identify and analyze the critical elements performing Ordinal Logistic Regression (OLR) that may impact the service quality of the MRT project. The findings are anticipated to provide valuable insights to the relevant authorities, enabling them to undertake proactive measures to enhance the user-friendliness of the project.

3. METHODOLOGY

3.1 Ordinal Logistic Regression

Ordered or Ordinal logistic regression (OLR) falls under the class of generalized linear models. The cumulative logit model, also known as the proportional odds model (POM), has been used in this study as OLR. The OLR model usually estimates the set of independent variables using both numerical and categorical responses (Ananth & Kleinbaum, 1997). Since this study consists of categorical variables, OLR is a suitable model to assess demographic characteristics. The model can be defined as:

$$\text{logit}\,(P(Y \leq j)) = \log\left[\frac{P(Y \leq j)}{1-P(Y \leq j)}\right] = \alpha_j + X\beta \quad j = 1, \ldots j-1 \qquad (1)$$

where P is the probability of dependent variable Y.
α = Regression intercept
β = Co-efficient of independent variable
X = Independent variable
n = 1,2,3…

3.2 Data Collection

Both web-based survey and in-person survey were used to capture opinions of respondents hailing from diverse socio-economics backgrounds on frequency of travel for variety of trip purpose. The online survey was created using Google Forms, incorporating both English and Bengali versions to ensure user-friendliness. The survey link was subsequently shared across social media, and emails within the Dhaka MRT commuters. Especially, it promoted through the personal and professional networks of the authors. Additionally, to complement the online data collection, in-person surveys were conducted at Uttara and Agargaon MRT stations. After manually data screening with care, the survey carried out between 1st September 2023 to 1st November 2023 (8 weeks) produced 498 valid responses.

The survey questionnaire comprises two sections. The first section extracted respondents` basic information on demographic characteristics: gender, age, education, employment status, income level, and travel characteristics: trip purpose and frequency of travel. The second section asked to rate fifteen different MRT service quality attributes along with Overall Service Quality (OSQ) based on the 5-point Likert scale ranging from 1 = Very dissatisfied to 5 = Very satisfied. The MRT service quality attributes have been selected based on the present literature and consultation with transportation experts.

3.3 Demographic Characteristics

Demographic characteristics of the respondents of the questionnaire survey are summarized in Table 1. The respondents, comprising 71.7% males and 28.3% females, showed diverse demographic characteristics. In terms of age, 38% were in the 18-25 years category, 54.2% in the 26-50 years range, and 7.8% in the 51-65 years bracket. Educational backgrounds varied, with 2.4% having primary education, 9.6% secondary education, 61.4% being graduates, and 26.5% having higher education. Employment status included 43.4% service holders, 5.4% businessmen, 39.8% students, and 4.2% unemployed, with 7.2% falling into the "Others" category. Regarding monthly income, 26.5% had less than 8,000 BDT, 11.4% had 8,001-16,000 BDT, 13.9% had 16,001-30,000 BDT, 36.7% had 30,001-50,000 BDT, and 11.4% had 50,000+ BDT. Trip purposes included work (38%), education (18.7%), shopping (6%), health (6%), and others (31.3%). The frequency of travel was distributed as daily (25.9%), 6-10 times a month (12.7%), 2-5 times a month (23.5%), and occasionally (38%).

Table 1: Demographic Characteristics of Respondents

Variables	Name	Count (N=498)	Percentage
Gender	Male	357	71.7
	Female	141	28.3
Age (years)	18-25	189	38
	26-50	270	54.2
	51-65	39	7.8
	65+	0	0
Education	Primary Education	12	2.4
	Secondary Education	48	9.6
	Graduated	306	61.4
	Higher Education	132	26.5
Employment Status	Service Holder	216	43.4
	Businessman	27	5.4
	Student	198	39.8
	Unemployed	21	4.2
	Others	36	7.2
Income Level (BDT/Month)	Less than 8,000	132	26.5
	8,001-16,000	57	11.4
	16,001-30,000	69	13.9
	30,001-50,000	183	36.7
	50,000 +	57	11.4
Trip Purpose	Work	189	38
	Education	93	18.7
	Shopping	30	6
	Health	30	6
	Others	156	31.3
Frequency of Travel	Daily	129	25.9
	6-10 times a month	63	12.7
	2-5 times a month	117	23.5
	Occasionally	189	38

4. RESULTS AND DISCUSSION

4.1 Descriptive Statistics

The category of three performance measures (Convenience & Comfort, Service & Economy, and Safety & Security) into fifteen variables, and a brief description of the variable along with mean and standard deviation in the assessment of the service quality of Dhaka MRT is provided in Table 2. All fifteen variables are categorized using a five-point Likert scale (five ratings: very dissatisfied, dissatisfied, neutral, satisfied and very satisfied). It can be seen from the Table 2 that Travel Time has the highest mean rating (4.43). On the contrary, Ticket Fare (3.33), Crowdedness in Train (3.48) and Washroom Facilities in Station (3.50) received the lowest mean rating out of fifteen independent attributes. It can be seen that out of fifteen variables total of eight variables have a mean rating of more than 3 and rest of the seven variables have a mean rating more than 4. This indicates the current service quality of Dhaka MRT is not good on the perspective of the commuters. Furthermore, Cronbach's alpha was used to test the reliability of the data. The reliability of the data is 0.921 which is more than standard value 0.8 (Sakib et al., 2024). Additionally, spearman's correlation test was performed between the independent variables where an absolute correlation coefficient >0.7 among two or more predictors indicates the presence of multicollinearity (Sakib et al., 2023). Spearman's correlation test revealed no multicollinearity (all correlation coefficients <0.7), indicating independence among the fifteen variables.

Table 2: List of Performance Measures and Their Components with Summary

Factors	Independent Variables	Description	Mean	SD
Convenience & Comfort	X1: Train Availability	Availability of trains for commuters	4.29	0.95
	X2: Travel Time	Duration taken for the journey	4.43	0.90
	X3: Punctuality of Timing	Adherence to the scheduled timetable	4.09	1.06
	X4: Crowdedness in Train	Level of congestion inside trains	3.48	1.11
	X5: Crowdedness in Station	Congestion level at station premises	3.69	1.24
	X6: Train Seat Comfort	Comfort of seats during the journey	3.65	1.19
Service & Economy	X7: Ticket Fare	Cost of train tickets	3.33	1.35
	X8: Ease of Purchasing Ticket	Convenience in the ticket purchasing process	3.67	1.25
	X9: Cleanliness in Train	Hygiene and cleanliness inside trains	4.28	0.99
	X10: Cleanliness in Station	Hygiene and cleanliness at station facilities	4.30	0.98
	X11: Washroom Facilities in Station	Availability and cleanliness of station washrooms	3.50	1.28
	X12: Courtesy of the Employees	Friendliness and helpfulness of staff	3.75	1.08
Safety & Security	X13: Sence of Safety in Station	Perception of safety at station premises	4.30	0.94
	X14: Sence of Safety in Train	Perception of safety during the train journey	4.30	0.94
	X15: Co-Passengers Behavior	Behavior of fellow passengers during the journey	3.95	1.02
	Cronbach's Alpha = 0.921			

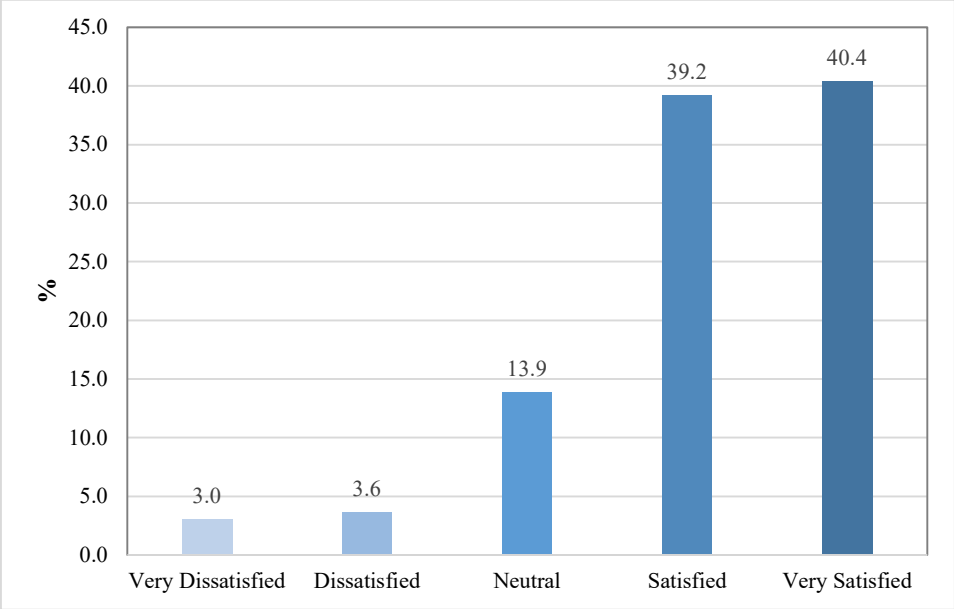

Figure 1: Perception Distribution of Overall Service Quality (OSQ)

Overall, perception distribution of Overall Service Quality (OSQ) of Dhaka MRT is presented in Figure 1. The survey utilized a five-point Likert scale, categorizing responses into Very Dissatisfied, Dissatisfied, Neutral, Satisfied, and Very Satisfied. Notably, Very Satisfied and Satisfied emerged as the most prevalent rating, representing the majority in the perception distribution (mean = 4.1, SD = 0.97). Commuters generally perceived the MRT SQ as Satisfied, with infrequent occurrences of Very Dissatisfied and Dissatisfied ratings.

4.2 Model Development

This section illustrates the estimation of models to examine the effect of fifteen MRT service quality attributes on OSQ. Model estimation was performed utilizing Ordinal Logistic Regression (OLR) at a 95% confidence interval. The dependent variables are based on the participant's perception of OSQ from Very Dissatisfied to Very Satisfied.

Maximum likelihood techniques utilized to perform the OLR model. It can be observed from Table 3 that Train Availability (X1), Crowdedness in Train (X4), Crowdedness in Station (X5), Ticket Fare (X7), Cleanliness in Train (X9), Cleanliness in Station (X10), Washroom Facilities in Station (X11), Courtesy of the Employees (X12), Co-Passengers Behavior (X15) has significant (p value < 0.05) impact on OSQ. The estimated coefficient has a positive impact on OSQ, this indicates that train availability, crowdedness in train, crowdedness in station, ticket fare, cleanliness in train, cleanliness in station, washroom facilities in station, courtesy of the employees, co-passengers' behavior in MRT service quality are associated with higher OSQ.

The estimated coefficient of significant variable X15: Co-Passengers Behavior is 0.893 (89.3%), X10: Cleanliness in Station is 0.672 (67.2%), X5: Crowdedness in Station is 0.634 (63.4%), X9: Cleanliness in Train is 0.6 (60%), X1: Train Availability is 0.522 is (52.2%), X11: Washroom Facilities in Station is 0.475 (47.5%), X4: Crowdedness in Train is 0.427 (42.7%), X12: Courtesy of the Employees is 0.408 (40.8%), and X7: Ticket Fare is 0.310 (31%). This result indicates that co-passenger's behavior has high impact and ticket fare has a comparatively low impact on OSQ among significant variables (Figure 2).

Table 3: Observed Results from OLR Model

Threshold	Estimated Coefficient	Standard Error	P value
Cut 1	8.748	0.855	0.000
Cut 2	10.920	0.897	0.000
Cut 3	14.897	1.134	0.000
Cut 4	18.959	1.277	0.000
Independent Variable			
X1	0.522	0.135	0.000
X2	0.033	0.146	0.820
X3	-0.017	0.145	0.909
X4	0.427	0.170	0.012
X5	0.634	0.147	0.000
X6	0.105	0.128	0.411
X7	0.310	0.101	0.002
X8	0.110	0.125	0.382
X9	0.600	0.163	0.000
X10	0.672	0.191	0.000
X11	0.475	0.132	0.000
X12	0.408	0.174	0.019
X13	0.167	0.237	0.480
X14	-0.030	0.222	0.892
X15	0.893	0.168	0.000
Goodness of fit			
-2 Log likelihood		318.954	
Likelihood-ratio chi-squared statistic (LR chi2)		589.85	
Prob > chi2		0.000	
AIC		675.907	
BIC		755.909	
Pseudo R Square		0.3804	

Note: X1: Train Availability, X2: Travel Time, X3: Punctuality of Timing, X4: Crowdedness in Train, X5: Crowdedness in Station, X6: Train Seat Comfort, X7: Ticket Fare, X8: Ease of Purchasing Ticket, X9: Cleanliness in Train, X10: Cleanliness in Station, X11: Washroom Facilities in Station, X12: Courtesy of the Employees, X13: Sence of Safety in Station, X14: Sence of Safety in Train, X15: Co-Passengers Behavior

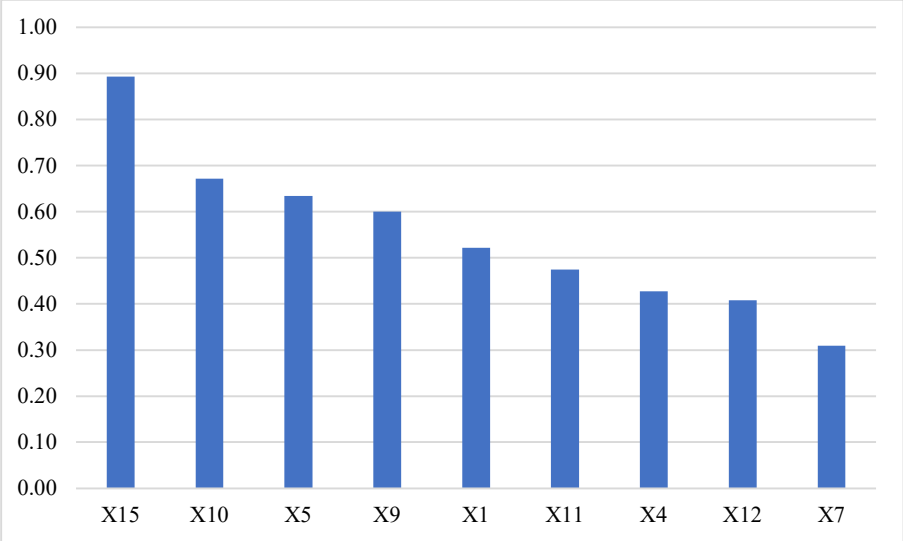

Figure 2: Ranking of MRT Service Quality Variables based on OLR (X15: Co-Passengers Behavior, X10: Cleanliness in Station, X5: Crowdedness in Station, X9: Cleanliness in Train, X1: Train Availability, X11: Washroom Facilities in Station, X4: Crowdedness in Train, X12: Courtesy of the Employees, X7: Ticket Fare)

4.3 Goodness of Fit

The suitability is assessed and confirmed using the following goodness of fit indicators for OLR: -2 log Likelihood (318.954), McFadden Pseudo R Square (0.3804) standard value range is 0.2-0.4 (Hu et al., 2006). The R square value indicates reliability of the model, where a greater R square value indicates a good correlation between the data (McFadden, 1973). The Likelihood-ratio chi-squared statistic (LR chi2) of 589.85 with a probability (Prob) of 0.000 indicates a statistically significant relationship between the independent variables and the dependent variable.

5. CONCLUSIONS

The study assessed OSQ based on the commuter's perception of Dhaka MRT and determined the significant factors affecting the OSQ applying Ordinal Logistic Regression (OLR). The questionnaire survey, carried out in both in-person and online for eight weeks, was able to collect 498 responses set after data screening. fifteen attributes are categorized using a five-point Likert scale. From the commuter's perspective, the OSQ of Dhaka MRT have a mean of 4.1 which indicates commuters are mostly satisfied with the current service of MRT. Nine attributes from OLR namely: Train Availability, Crowdedness in Train, Crowdedness in Station, Ticket Fare, Cleanliness in Train, Cleanliness in Station, Washroom Facilities in Station, Courtesy of The Employees, Co-Passengers' Behavior are found to be statistically significant and positively influence the OSQ of MRT. From the OLR model result (Figure 2), Co-Passengers Behavior is the most important and Ticket Fare is the least important attribute among the significant variables which affect the OSQ.

One of the limitations of this study is that it only considered fifteen attributes only, further studies can be carried out considering more broad factors. Moreover, the duration of the survey is shorter in the context of the newly introduced MRT, limiting the ability to capture long-term trends or changes in commuter perceptions over an extended period. For future studies, it would be beneficial to conduct more extended surveys over multiple time periods to provide a comprehensive analysis of evolving commuter patterns and preferences in response to the newly introduced MRT system. Besides, only OLR has been used to model the user perception of OSQ. Further studies can be conducted using Bayesian OLR, classical and Bayesian Structured Equation Modeling, Machine Learning techniques to explore a more diverse range of analysis methods and enhance the robustness of the results.

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