

Urban Transit for Sustainable Mobility: Passenger Centered Evaluation of Islamabad Metro Bus

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Abstract

Passenger satisfaction with metro bus services is critical for sustainable urban mobility but remains underexplored in Pakistan. Using Partial Least Squares Structural Equation Modeling (PLS-SEM) on survey data from 400 households in Islamabad, this study identifies the main service-quality drivers of satisfaction. Safety and assurance, reliability, responsiveness, and automated systems emerge as the strongest predictors, while demographic factors and distance to stops show little influence. These findings suggest that prioritizing safety, reliability, and technology-based improvements could enhance passenger experience and inform policies aligned with SDG 9 (Industry, Innovation, and Infrastructure) and SDG 11 (Sustainable Cities and Communities).

Keywords: Metro bus services, passenger satisfaction, service quality, reliability

INTRODUCTION

Rapid urbanization in developing countries has strained transport systems, driving up private vehicle use and causing congestion. Bus Rapid Transit (BRT), first pioneered in Curitiba and later adopted by over 160 cities worldwide ¹, offers a cost-effective remedy. High-capacity feeder buses link inner neighborhoods to dedicated BRT corridors, improving accessibility. Inspired by Istanbul's system, Lahore launched Pakistan's first BRT, which has been widely praised and demonstrates how modern design standards can address urban mobility challenges. Recent studies ^{2,3} approve that modern BRT systems in South Asia and East Asia significantly improve mobility outcomes when service quality is associated with passenger expectations.

In Punjab, mounting traffic woes led the provincial government to establish the Punjab Mass Transit Authority (PMA) and roll out Metro Bus Services (MBS). This network aims to deliver safe, reliable, and affordable travel particularly benefiting low-income commuters by widening access to employment markets. Before PMBS began operation, roughly 210,000 vehicles clogged three major corridors, carrying about 525,000 daily passengers; nearly 158,000 of them traveled specifically between the twin cities on those routes ⁴. The use of importance-performance and multivariate frameworks to analyze passenger satisfaction in Bus Rapid Transit (BRT) systems has grown. In a developing-country BRT environment, Singh, and Kumar⁵ used Principal Component Analysis to identify six key aspects that together explain overall satisfaction: connection, comfort & convenience, safety, cleanliness, station amenities, and information reliability. More recent evidence Rahman, et al.⁶ highlights that affordability and reliability remain decisive factors for continued ridership in South Asian transit systems.

Understanding rider satisfaction is crucial for public transport success. Unlike service-quality metrics, satisfaction reflects how well transit meets users' expectations, shaped by personal needs, prior experiences, and objective service attributes. Surveys have long gauged perceptions—for example, Stradling, et al.⁷ identified 68 liked or disliked features in Edinburgh's bus system, while Felleson, and Friman⁸ showed staff competence, safety, shelter design, information reliability, schedule adherence, and frequency significantly influence satisfaction across nine European cities. Recent comparative studies ^{9,10} further suggest that technology-enabled ticketing and real-time information systems are emerging as critical predictors of satisfaction in developing-country contexts.

Despite the clear benefits of BRT reducing congestion and cutting greenhouse gases in line with SDG 11 (Sustainable Cities) and SDG 13 (Climate Action) few studies apply rigorous modeling to uncover the hidden drivers of satisfaction. Most evaluations of Islamabad's Metro Bus system remain descriptive. By integrating passenger surveys with objective service-quality data and employing Structural Equation Modeling (SEM), this research quantifies the latent factors that truly matter to riders. These insights will help policymakers and operators implement targeted, evidence-based improvements, boost overall ridership, curb private-vehicle use, and advance Pakistan's sustainable mobility goals, while offering a replicable framework for other cities seeking to enhance public transit delivery.

As a result, this study aims to achieve three major goals. First, it looks for the main aspects of service quality that have a big impact on how satisfied customers are with Islamabad's Metro Bus Service, like safety, accessibility, responsiveness, reliability, affordability, and technology. Second, it looks at how the link between service quality and satisfaction is moderated by sociodemographic parameters like gender, age, income, and trip characteristics. Third, it seeks to draw policy implications from the PLS-SEM results in order to drive evidence-based policies for improving passenger happiness and advancing sustainable urban transportation in Pakistan.

LITERATURE REVIEW

Urbanization has sharply increased the demand for reliable public transit worldwide, driving substantial investments in infrastructure ^{11,12}. While improved service quality often boosts ridership ¹³⁻¹⁵, those upgrades can carry high costs though simple measures (e.g. women-only ticket booths) can still yield big gains at low expense ^{16,17}. A user-centric approach one that actively incorporates passenger feedback alongside agency priorities has emerged as vital for tailoring improvements to each city's needs ^{18,19}.

Regional studies reveal distinct satisfaction drivers. In Nigeria, cost and safety top the list ²⁰, whereas in South Africa it's affordability and responsiveness ^{21,22}. Colombian riders prioritize information, ergonomics, and accessibility, while New Yorkers focus on frequency, timeliness, and speed ^{23,24}. In South Asia, availability and comfort stand out in India ²⁵, as do demographic factors age, education, income in Dhaka's prospective BRT uptake ²⁶. Lahore's Metro Bus has delivered strong ridership but still needs better schedule adherence and capacity management ²⁷.

Beyond individual attributes, mode choice and trip length also shape satisfaction: walkers and cyclists often report higher contentment than car or bus users, and shorter commutes correlate with better perceptions²⁸. Critically, transport access underpins social inclusion and well-being—poor networks can exacerbate exclusion²⁹. These findings underscore that boosting service quality and accessibility not only raises satisfaction but also enhances urban livability^{30,31}.

Methodologically, recent studies have moved beyond descriptive surveys. Al-haj, et al.³² applied SEM in Amman's BRT, isolating latent drivers like comfort, safety, and reliability. Saxena, et al.³³ showed that perceived trip time, in-vehicle comfort, and fare fairness explain over 60 percent of satisfaction variation in Bhopal's BRT. Saeidi, et al.³⁴ found that mode-specific factors—station accessibility for metro, frequency for BRT—differentially affect user happiness. In Pakistan, Anam & Ali (2025) used factor and choice modeling on Lahore's Orange Line, identifying safety, convenience, and environmental commitment as top predictors of future use. Yet few studies integrate objective service metrics with passenger perceptions via SEM—an evidence gap this research will fill, offering a replicable framework for cities aiming to optimize transit performance.

The comprehensive analysis of research on public transport round the world exposes the MTR systems key components impacting the effectiveness and satisfaction. Need for better public transit is operated by urbanization, and while raising service standards might be expensive, focused, economical actions can also have a big impact. It is imperious to adopt a passenger-centric approach that prioritizes particular regional demands and qualities to be able to boost ridership and optimize overall contentment with conveyance systems for public.

METHODOLOGY

This segment provides the methodology for Metro bus services and Passenger self-satisfaction in Pakistan. On the basis of literature, we develop the following conceptual framework.

Theoretical Background

The service quality model recognized by Parasuraman et al. (1988). This SERVQUAL standard allows for the measurement and capturing of the service quality that customers acquire. This SERVQUAL approach has been utilized by numerous prior studies to assess consumer satisfaction in public transit. Many nations have used the SERVQUAL model, including the United States. Furthermore, SERVQUAL has been widely applied across various service industries, including retail banking, public transit, and other sectors. Figure 1 presents the framework of the current study, which focuses on passengers' satisfaction with the service quality of BRT services in Islamabad, Pakistan. The study evaluates the impact of metro bus service quality on customer satisfaction using four key dimensions of service quality.

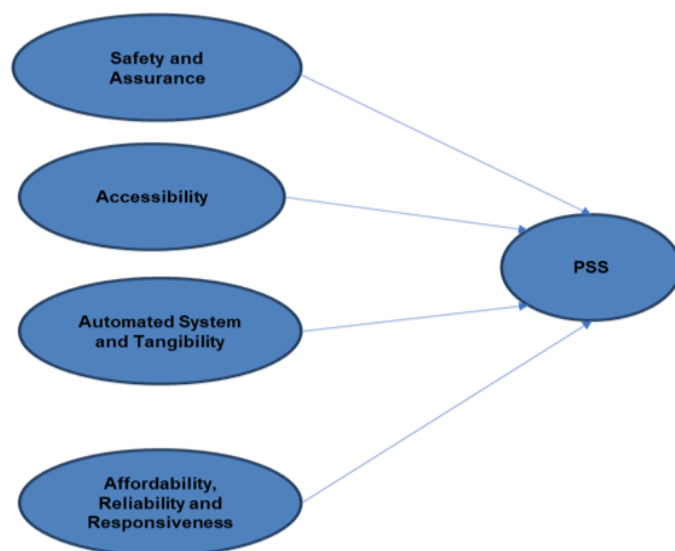


Figure 1.1: Conceptual Framework of the study on Metro bus services and Passenger Satisfaction

Figure 1.1 illustrates the conceptual framework, where passenger satisfaction serves as the dependent variable. In this model, various dimensions of service quality - namely safety and assurance, accessibility, automated systems, reliability, affordability, and responsiveness - function as independent variables. The hypotheses for this framework are as follows: -

- H1:** The accessibility of BRT has a significant relationship with passengers’ self-satisfaction.
- H2:** The safety and assurance provided by BRT have a significant positive relationship with passengers’ satisfaction.
- H3:** Passenger self-satisfaction has a considerable positive association with both automated systems and BRT reliability.
- H4:** Passenger satisfaction has a considerable positive link with BRT’s affordability, reliability, and responsiveness.

Measurement of variable

The questionnaire was structured into three sections: (1) items evaluating the dimensions of service quality, (2) an valuation of satisfaction overall, and (3) information about demographic, including gender, age group, income, and status of employment. The questionnaire was adapted based on prior research.

Table 1: Variables with Definitions

Construct	Definition	Scale & Items
Accessibility	Ease of reaching and using the service	5-point Likert (5 items)
Affordability	Perceived fairness and reasonableness of fares	5-point Likert (5 items)
Reliability	Consistency and dependability of service delivery	5-point Likert (5 items)
Responsiveness	Willingness and promptness in handling passenger inquiries	5-point Likert (5 items)
Safety & Assurance	Staff competence to build trust and guarantee user security	5-point Likert (5 items)
Automated System & Tangibility	Quality of equipment, facilities, and visible infrastructure	5-point Likert (5 items)
Passenger Self-Satisfaction	Overall traveller satisfaction with mobility services	5-point scale

Study Area

This study looks at how passengers in Pakistan’s capital, Islamabad, use metro bus services and how happy they are. Daily travel expenses are heavily influenced by home consumption as well as commercial and industrial activity in the area. The varied environment of Islamabad provides a special setting for investigating the dynamic relationship between the use of domestic transport services and the welfare of passengers. The results are intended to offer insightful information to locals, decision-makers, and scholars who are curious about the effectiveness of transportation services and general well-being in similar areas.

Sample Size & Data Collection

Data from surveys of Pakistani residents in Islamabad was used to test the study’s hypothesis. The largest province in the nation and an important center of politics, economy, and culture, provides the main location for this study. Convenient sampling is an excellent approach for data collecting when conducting exploratory investigations or when a researcher has limited time and resources to collect data. For those reasons, it was employed for this data collection. The current study used a practical sampling technique to gather primary data. For the purposes of this study’s analysis, a sample size of 400 families was chosen from among the estimated 12 lakh people who live in Islamabad’s urban areas, according to recent surveys. The following equation served as the basis for the formula used to calculate the sample size:

$$S = Z^2 \times P \times \frac{(1 - P)}{M^2}$$

Where Z is the critical value of the normal distribution at the chosen confidence level, where S is the sample size. P stands for the 50% or 0.5 population percentage that is assumed, and M stands for the 5% margin of error.

Survey Instrument

Distinct section of the questionnaire used to collect the data: general information, respondent demographic information (such as family size, age, income, and education level), and A comprehensive questionnaire on passenger satisfaction with metro bus services was used to collect data. The study used route modeling to determine how subjective norms affect adaption strategies and regression analysis with a 5% standard error margin to analyze the correlations between factors and Smart PLS. This selected method can be useful to investigate both linear and additive causal theories, both of which have support from previous studies.

Analytical Approach

The relationship between endogenous and exogenous latent variables was represented in the study using equations. The inner model, also known as the structural model, establishes the link between the objects and the latent variables. PLS is intended for use with recursive models, such as causal chain systems. The measurement model describes the connections between indicator and endogenous variables. The correlations between latent variables and the indicators that correspond to them are captured by the structural regression model.

Measurement Model

Weight relation scores are used in the measurement model to reflect the differences between indicators and their latent variables. The following is an expression of the equations for these weight connections:-

$$\epsilon_b = \sum_{kb} W_{kb} X_{kb} \quad (5)$$

$$\eta_i = \sum_{ki} W_{ki} Y_{ki} \quad (6)$$

Where, The latent variables ϵ_b and η_i were estimated using the weights “k.” W_{kb} also displays the weights.

Convergent validity is assessed using the measurement model’s convergent validity (outer model), which establishes the strength of the correlation between latent variables and their corresponding indicator variables in the reflexive measurement paradigm. Reliability evaluation is an essential test for the measurement model, or outer model, in the SEM-PLS paradigm. AVE stands for Average Variance Extracted. A composite reliability (CR) score of more than 0.7 indicates high levels of trustworthiness for latent variables. High levels of dependability for latent variables are indicated by a composite reliability (CR) score greater than one:-

$$CR = \frac{(\sum_{i=1}^n \lambda_i)^2}{(\sum_{i=1}^n \lambda_i)^2 + \sum_{i=1}^n e_i} \quad (7)$$

Average Variance Extract (AVE) can be determined by the following formula:-

$$AVE = \frac{\sum_{i=1}^n \lambda_i^2}{\sum_{i=1}^n \lambda_i^2 + \sum_{i=1}^n e_i}$$

We use above formulas to calculate CR and AVE for measurement model.

Structural Model

The structural model explains the relationships between latent variables, showcasing how they influence one another within the framework. In this case, our latent variables are the Service Quality dimensions, and the outcome variable is passenger satisfaction.

$$PSS = \beta_1 \cdot SA + \beta_2 \cdot Ac + \beta_3 \cdot ASAT + \beta_4 \cdot RAAR + \beta_5 \cdot UOMS + \beta_6 \cdot Dis + \beta_7 \cdot Age + \beta_8 \cdot FMI + \epsilon$$

Where:

- PSS = Passenger Self Satisfaction
- SA = Safety and Assurance
- Ac = Accessibility
- ASAT= Automated System and Tangibility
- RAAR = Reliability, Affordability, and Responsiveness
- UOMS=Daily use of metro bus services
- Dis=Distance in minutes from home to metro stop
- Age = Age in no of years
- FMI=Family total monthly income
- $\beta_1, \beta_2, \beta_3, \beta_4, \beta_5, \beta_6, \beta_7$, and β_8 = Path coefficients
- ϵ = Error term

RESULTS AND DISCUSSION

Descriptive Analysis

Descriptive analysis enhances the study’s comprehension by providing a foundation for researchers and reviewers, preparing them for a more detailed examination of the econometric analysis within the study’s defined framework³⁵. The research area’s household demographics are displayed in Table No. (1). People’s ability to seize opportunities is found to be significantly influenced by their age, which is strongly correlated with their level of responsibility. These conclusions are supported by the data that was gathered. Table (1) provides a clear picture of the age distribution of the study’s respondents. Seventy-two percent of registered members are between the ages of 25 and 30. Sixteen percent of the total membership is actively involved in developmental initiatives. Addressing and reducing gender-based differences in well-being outcomes is essential to improving subjective well-being for everyone. There was a modest predominance of male representation in this study, with female participants making up 47% of the sample and male participants making up 53%.

Of the 400 respondents, 71% lived in households with five or seven people, and 12% reported living in households with fewer than four people. Additionally, 16% of respondents said they lived in homes with eight to ten people.

With 29.31% of valid replies, an associate degree was the most frequent general education level among respondents and the second most common educational level overall. Conversely, 29% of respondents have a bachelor’s degree. However, 34% of respondents claimed to have simply completed high school. Master’s and doctoral degrees earned low response rates and were the least frequently mentioned educational levels.

According to Table 1, the majority of respondents (16%) reported earning less than \$50,000, however a sizable portion made between \$100,000 and \$250,000. Just 2.40 percent of respondents said they made between \$251 000 and \$300,000.

Table 2: Demographical Characteristics of Household

Demographics	Frequencies	Percentages (%)
Gender		
Female	188	47%
Male	212	53%
Age		
20- 25	291	72.75%
26 -30	64	16%
30 - 45	45	11.25%
Household Size		
Under - 4HH	51	12.75%
5-7 - HH	284	71%
08-10 - HH	63	16.25%
General Education		
Matric	112	22.4%
ADP	84	16.8%
B.A/B.SC	148	29.6%
M.A/M.SC	148	29.6%
PhD	8	1.6%
Family Income		
less than 50000	67	16.8%
50000 to 100,000	150	37.5%
100,000 to 200000	117	29.3%
200000 and above	66	16.6%

The bar chart shows that Staff Behavior had the highest aggregate satisfaction score (70.3%), showing strong positive impressions of crew professionalism and civility. Air conditioning has the lowest rating at 50.0%, underlining climate control as the biggest issue in the passenger experience. Seat Comfort (64.8%) and Security (62.8%) achieved good scores, indicating positive feedback on physical comfort and safety measures. In contrast, Ease of Access (52.7%) and Ticketing System (53.9%) are barely above the midway point, indicating potential for expediting entry and payment operations. Punctuality (56.6%) and Seating Capacity (57.2%) provide opportunities for schedule optimization and capacity management. The general pattern emphasizes that while interpersonal service and basic amenities work

well, technological and infrastructure enhancements particularly in air-conditioning, access, and ticket should be prioritized to elevate the overall satisfaction level.

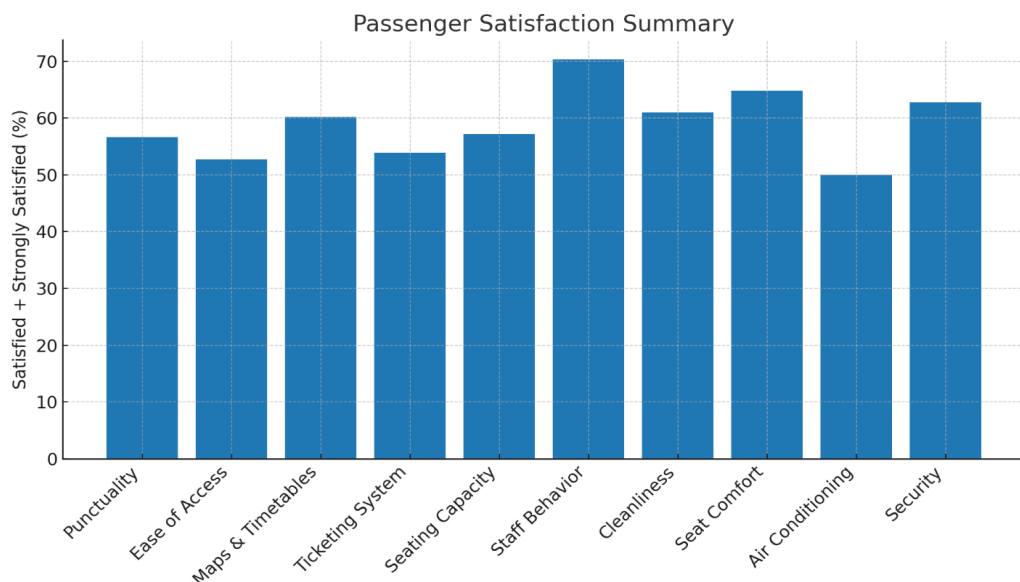


Figure 1: Passenger Usage and Satisfaction from Metro Bus Services Descriptive Analysis

Measurement Model

Factor Loadings: These items are strong markers of the corresponding constructs, as evidenced by their comparatively high item loadings, especially for the constructions. A significant degree of convergent validity is indicated by a substantial value of the standardized loading factor (λ)³⁵. A loading value of 0.5 or greater indicates a high level of convergent validity, according Hair et al. (2010). The results of the convergent validity evaluation carried out in the context of Islamabad, Pakistan, are explained by the outer model loadings, which are shown in Table 1 and Figure 1.

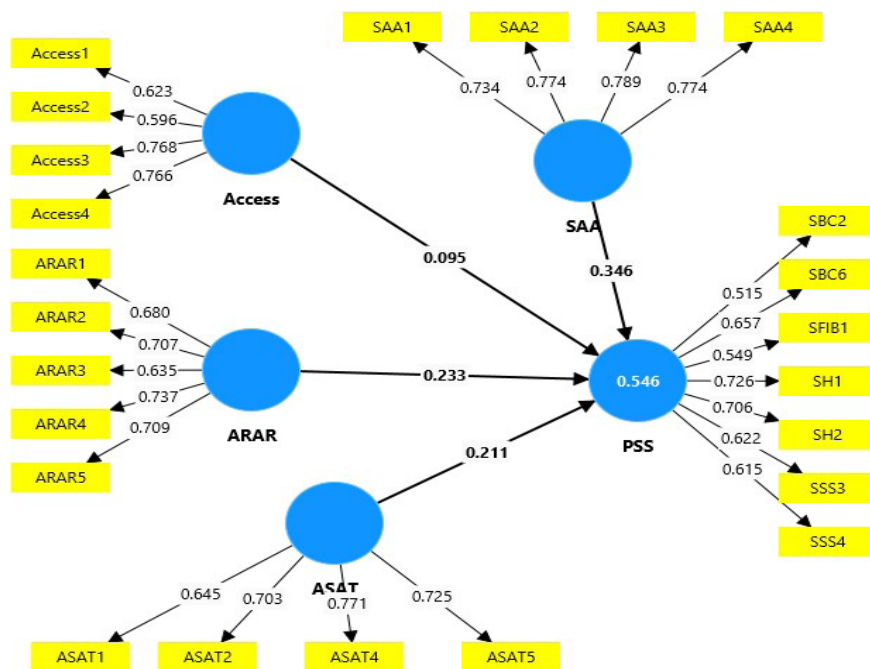


Figure 2: Confirmatory factor analysis (CFA) of latent variables.

Table 3: Results of Confirmatory Factor Analysis

Construct	Item	Standard factor loading	Cronbach's alpha	Composite reliability	AVE
Accessibility to metro bus stops			0.645	0.785	0.502
I primarily walk to reach the station.	Access1	0.623			
Metro route connect my desired (routine) destinations.	Access2	0.596			
Metro Bus route convenient to get around different destinations in the twin cities.	Access3	0.768			
For me, Metro Bus Station (MBS) is Very easy to access	Access4	0.766			
Automated system and tangibility			0.677	0.804	0.508
I never feel any difficulty in using the automated ticket system at the Metro Bus station	ASAT1	0.645			
Air condition in the Metro Bus always work properly	ASAT2	0.703			
The free WiFi in the Metro Bus work properly	ASAT4	0.771			
The cleanliness and maintenance at the Metro Bus station and inside buses is very good.	ASAT5	0.725			
The seats in the Metro Bus are comfortable enough for travelling	ASAT1	0.645			
Affordability, reliability and responsiveness			0.731	0.823	0.48
I think travelling on the Metro Bus is affordable for passengers	ARAR1	0.680			
Information system regarding Metro Bus schedule and road map is comprehensive.	ARAR2	0.707			
The complaint was effectively addressed by the MBS staff	ARAR3	0.635			
	ARAR4	0.737			
MBS usually doesn't take much time; the journey is relatively quick.	ARAR5	0.709			
Safety and assurance			0.768	0.852	0.592
I always feel safe at the Metro Bus station.	SAA1	0.734			
I am satisfied with the measures taken (such as CCTV and security guards) for safety of female passengers by the Metro Bus Authority.	SAA2	0.774			
When I compare the safety level of the Metro Bus with other transport facility use I will prefer MBS then other (Metro Bus System versus Other Transport Facility).	SAA3	0.789			
The behaviour of the Metro Bus staff towards female passengers is respectful.	SAA4	0.774			
Satisfaction from mobility			0.762	0.821	0.400
The presence of bus comfort spaces at level boarding	SBC2	0.515			
Bus Comfort Safety of Passengers on Board	SBC6	0.657			
Facilities inside buses air conditioning service	SFIB1	0.549			
Headway bus punctuality and on-time	SH1	0.726			
Headway easy access to bus	SH2	0.706			
Station services and service guidelines (including information delays, timetables, and map availability)	SSS3	0.622			
Station services card/and ticketing system	SSS4	0.615			

Constructs generally exhibit acceptable levels of reliability and validity, with some variability. Constructs related to “Safety and Assurance” and “Automated System and Tangibility” show strong factor loadings and reliability³⁵. Constructs like “Accessibility to Metro Bus Stops” and “Satisfaction from Mobility” show some areas of concern with reliability and convergent validity. Non-linearities in model behavior, where small shocks in specific variables lead to large outcome deviations, are common in theoretical and empirical models. Low Cronbach's alpha values (typically < 0.70) suggest that the items within a construct lack internal consistency, undermining the scale's reliability. Similarly, item loadings below the acceptable threshold (commonly 0.50) indicate weak association with the underlying latent construct, reducing construct validity.

Evaluation of the Inner Structural Model and Hypothesis Examination

Complex relationships between latent variables are revealed by the inner structural models. The structural model is balanced in order to validate the variable coefficients using partial least squares analysis. The t-statistics derived from bootstrapping with a 400-person sample size serve as the foundation for this validation. In particular, the accompanying figure and table show the coefficients for the parameters within the inner model for Islamabad, Pakistan. The path coefficient between “Access” and “PSS” is 0.034, suggesting a marginally favorable impact. The findings indicate that accessibility has a statistically significant effect on passenger self-satisfaction, with a t-statistic of 2.26, significant at the 0.05 level, and a p-value of 0.024. Confidence intervals (CIs) for the path coefficients in your model, we use the standard method: Assuming a 95% confidence level, the critical value $z=1.96$. The confidence intervals give information about the accuracy and dependability of each estimate by indicating the range in which the true path coefficient is most likely to fall. Higher confidence in the stability of the relationship between constructs is indicated by a narrower interval.

Table 4: Path Parameter Coefficients

Construct	Sample mean (M)	Standard Error (SE)	t Statistic (t)	p-Value
Access -> PSS	0.034	0.079	2.26	0.024
ARAR -> PSS	0.209	0.055	3.77	0.000
ASAT -> PSS	0.173	0.042	4.07	0.000
SAA -> PSS	0.293	0.046	6.32	0.000
FMI -> PSS	0.027	0.022	1.23	0.217
Distance -> PSS	-0.004	0.003	1.52	0.128
UOMB -> PSS	0.069	0.022	3.19	0.001
AGE -> PSS	-0.004	0.005	0.764	0.446

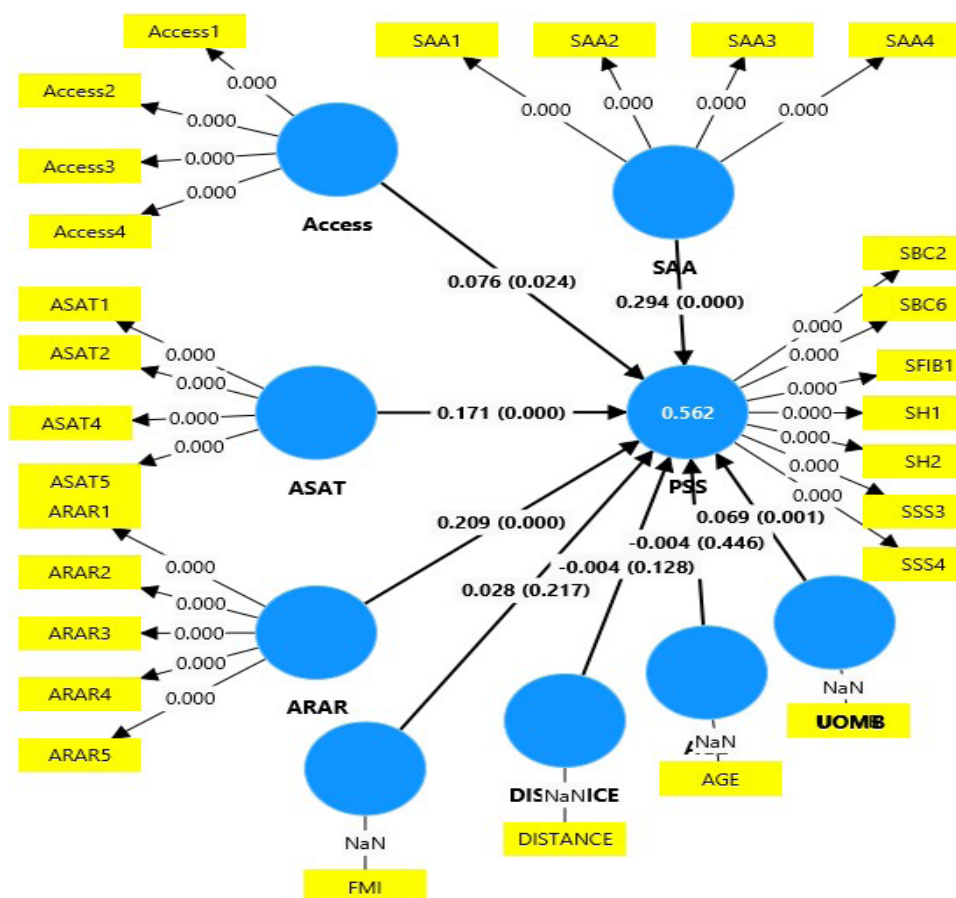


Figure 3: Structural Model

Metro bus service Affordability, Reliability, and Responsiveness (ARAR) have positive and significant impact on passenger satisfaction. Our result is also supported by Moriarty, and Hamer³⁶, Van & Lange (2021) study. They also discover relationship between service affordability and about passenger's satisfaction in public services. This study shows that affordability, along with reliability and responsiveness, plays a substantial role in enhancing overall satisfaction, aligning with the moderate positive effect found in their analysis.

The path coefficient from Automated System and Tangibility to Passenger self-satisfaction is 0.173, showing a positive and significant effect. This implies that better automated systems and tangibility have a notable impact on perceived service satisfaction. Lovelock, and Wirtz³⁷ also discuss how advancements in technology and tangible aspects of service delivery, such as automated systems, significantly impact service quality and customer satisfaction. They emphasize that well-implemented technology enhances customer experience by increasing efficiency and reliability, thereby positively affecting satisfaction. Safety and Assurance have positive and significant impact on Passenger self-satisfaction. With a t-statistic of 6.32 and a p-value of 0.000, this effect is highly significant. This suggests that safety and assurance factors have the strongest impact on passenger satisfaction among the constructs measured. Our study result supported by Zhang, and Zhang³⁸ investigate how safety perceptions in public transportation impact passenger satisfaction. Their findings indicate that safety and assurance are critical determinants of satisfaction, supporting the substantial positive effect observed in analysis. According to the model, there is no discernible relationship between the family's monthly income and passenger pleasure. A plausible explanation for the lack of a significant correlation between Family Monthly Income (FMI) and Perceived Self Satisfaction (PSS) in this model could be the perception of the metro bus service as an obligatory rather than optional service. This indicates that rather than using the metro bus services as a choice influenced by their income level, people of all income levels use them as a need for everyday travel. Therefore, rather than their financial situation, the quality and dependability of the service itself have a greater impact on their pleasure with it.

The path coefficient from Distance from stop to passenger self-satisfaction is -0.004, which is a very small but negative effect. This proposes that the distance factor has minimal and non-significant impact on perceived service satisfaction. Jiang, and Dunn³⁹ study support. our results by examines factors affecting public transport satisfaction in Hong Kong, finding that distance has a minor effect on overall satisfaction compared to factors like service quality and reliability. Usage of Metro Bus to passenger satisfaction is 0.069, indicating a positive and significant effect. The t-statistic of 3.19 and p-value of 0.001 suggest that a statistically significant relationship. This implies that increased usage of the Metro Bus positively affects passenger self-satisfaction, though the effect size is relatively small. The present result also supported by Chen, and Chang⁴⁰ investigate the relationships between service quality, customer satisfaction, and loyalty in various service sectors, including public transport. Their study shows that while frequent usage positively affects satisfaction, the effect size is often small compared to other factors like perceived service quality. According to the current study, passenger happiness in this model is not greatly impacted by age. The Expectation-Disconfirmation Theory, put out by Oliver⁴¹, contends that the discrepancy between expected and perceived service performance affects customer satisfaction. Frequent usage of a service like a Metro Bus could lead to varying levels of satisfaction based on whether service experiences consistently meet, exceed, or fall short of expectations. A small positive effect might indicate that while usage correlates with satisfaction, other factors (like service quality or reliability) may have a more substantial impact. De Borger, and Fosgerau⁴² explores how various aspects of public transport quality impact ridership and satisfaction. A small positive effect of usage on satisfaction aligns with findings that while higher quality and improved service features drive greater satisfaction, the relationship between usage and satisfaction can be influenced by multiple factors.

CONCLUSIONS

The present study offers a brief, service centric proposal for elevating metro bus satisfaction by binding structural equation modeling to reveal the essential roles of Affordability, Reliability, and Responsiveness (ARAR); Automated Systems and Tangibility (ASAT); and Safety and Assurance (SAA) in shaping passenger well-being. While ARAR and ASAT each contribute moderate, significant boosts to user experience, SAA stands out as the strongest predictor of satisfaction, underscoring that security and operational dependability are nonnegotiable. Notably, socioeconomic and locational variables Family Monthly Income⁴³, Distance to Stop, and Age exert no meaningful influence, suggesting that targeted service enhancements can bridge demographic and geographic divides. Frequent ridership

further amplifies perceived benefits, indicating that habitual users derive greater satisfaction from consistent, high-quality service. By prioritizing affordability, reliability, advanced technology, and safety, transit operators can not only optimize system performance but also encourage a modal shift away from private vehicles, thereby alleviating congestion, reducing greenhouse-gas emissions, and promoting public health. This integrative framework aligns directly with Sustainable Development Goals 11 (Sustainable Cities and Communities), 9 (Industry, Innovation, and Infrastructure), and 3 (Good Health and Well-Being), offering policymakers and operators an evidence-based roadmap for actionable improvements that enhance commuter welfare and advance sustainable urban mobility both in Islamabad and beyond.

Policy Implications

- Introduce targeted subsidies or fare reduction schemes for students, senior citizens, and low-income groups to ensure the service is affordable for all.
- Increase the frequency of services, primarily during peak hours, to cut down on wait times and guarantee prompt adjustments. Reduce wait times and expedite the boarding process by implementing contactless and mobile ticketing systems.
- Install digital displays at bus stops and develop mobile apps to provide real-time updates on bus locations, arrival times, and service alerts.
- Provide drivers and employees with frequent safety training to improve their capacity to handle crises and offer support.
- In order to guarantee that more people have access to dependable public transportation, metro bus lines need to expanded remote and under serviced communities.

Limitations and Future Directions of the Study

This study is limited to one urban context in Pakistan, limiting the ability to be generalized of the findings. The sample size, while adequate for PLS-SEM, was insufficient to conduct thorough analysis on the provincial or national levels. Furthermore, the emphasis was focused on service quality concerns, rather than broader institutional or environmental considerations. Future study should cover various provinces and use larger, more diverse samples to provide context-specific policy findings. Comparative studies at the provincial and national levels could assist tailor transportation plans to regional demands. longitudinal information might track changes in passenger satisfaction over time, and advanced analytical methods like multi-group analysis could examine for differences between demographic groups.

Ethics and Consent Statement:

This study was conducted in accordance with ethical guidelines and approved by the relevant institutional ethics review board. Informed consent was obtained from all participants prior to their involvement in the study, and participants were assured of confidentiality, anonymity, and their right to withdraw at any stage without consequence.

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