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Passenger Satisfaction as a Mediator of Service Quality and Perceived Sustainability Effects on Bus Rapid Transit Loyalty: Evidence from Transjakarta

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Abstract

This study examines passenger satisfaction as a mediator linking service quality and perceived sustainability to Transjakarta passenger loyalty. It reanalyses a 2021 convenience survey of 260 passengers across Jakarta's five administrative cities; direct relationships from these data were previously published. The reported covariance-based structural equation model (LISREL 8.80) contains 39 indicators. Construct reliability ranges from 0.94 to 0.98 and reported average variance extracted from 0.62 to 0.76. Fit is mixed: CFI = 0.99 and SRMR = 0.060, but GFI = 0.75 and AGFI = 0.70. Service quality (β = 0.49) and perceived sustainability (β = 0.46) are positively associated with satisfaction (R^2 = 0.85). Satisfaction (β = 0.45), service quality (β = 0.27), and perceived sustainability (β = 0.21) are positively associated with loyalty (R^2 = 0.79). Products of the reported standardized coefficients yield indirect effects of 0.221 and 0.207, representing approximately 45% and 50% of the respective total associations. These patterns are consistent with complementary partial mediation. However, the coefficient scales and standard errors require confirmation against the original output before definitive inference about indirect effects. The cross-sectional design does not establish causal mediation. Operators may use the findings to guide improvements in service reliability, accessibility, and perceived sustainability benefits.

Keywords: Bus Rapid Transit; Passenger Loyalty; Passenger Satisfaction; Perceived Sustainability; SERVQUAL; Mediation

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INTRODUCTION

Service reliability and safety remain persistent problems for public bus transport in developing countries (Ngoc et al., 2017). Poor service experiences can push passengers toward private vehicles and worsen congestion. Operators therefore need to understand the factors that retain users, in addition to expanding service coverage (van Lierop et al., 2018).

Transjakarta began operating in 2004 as the first bus rapid transit (BRT) system in Southeast Asia (Ernst, 2005). Simanullang et al. (2022) reported a network of 251.2 km, 260 stops, and 13 corridors during their study period. These figures describe the historical context, not the current state of the network. Network expansion also does not necessarily reduce dependence on private vehicles (Gaduh et al., 2022; Chiu, 2022).

Earlier studies recorded complaints about waiting times, crowding, arrival information, intrusions into dedicated lanes, and driver behavior (Simanullang et al., 2022). Rahayu et al. (2022) also linked comfort and waiting-time problems to passenger satisfaction on Corridor I. These problems make the travel experience an important basis for building loyalty.

The literature has examined the relationships among service quality, satisfaction, and loyalty (van Lierop & El-Geneidy, 2016; van Lierop et al., 2018). However, the economic, social, and environmental benefits perceived by passengers need to be analyzed together with service quality. The form of satisfaction's mediation also differs across studies: de Oña (2021) reported full mediation, whereas Nguyen-Phuoc et al. (2021) found that the direct relationship remained significant. This difference motivates a test in the context of Jakarta's BRT.

This article reuses a survey whose direct relationships were reported by Simanullang et al. (2022). Its contribution is limited to a supplementary analysis of indirect paths, total effects, and the proportion of mediation, together with the presentation of the AVE values reported in the source manuscript. The research question is the extent to which satisfaction bridges the relationships of service quality and perceived sustainability with passenger loyalty. These data are not an independent sample from the earlier publication.

LITERATURE REVIEW AND HYPOTHESIS DEVELOPMENT

Public Transport Service Quality

SERVQUAL covers reliability, responsiveness, assurance, empathy, and tangibles (Parasuraman et al., 1988). For bus services, these dimensions include schedule adherence, complaint handling, safety, staff friendliness, and the condition of vehicles and stops. Attribute priorities can differ by context and passenger group

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(Saleem et al., 2023; Singh & Kathuria, 2023). Zheng et al. (2021) also showed that improvement priorities can change after BRT operations begin.

Perceived Transport Sustainability

Sustainability emphasizes meeting present needs without compromising the ability of future generations to meet theirs (Kuhlman & Farrington, 2010). This study measures passengers' perceptions of the economic, social, and environmental benefits of Transjakarta. The scope covers fare affordability, travel efficiency, equity of access, and perceived environmental benefits. These perception measures do not replace measurements of actual emissions or environmental performance.

Kamaruddin et al. (2017) examined public transport users' expectations together with satisfaction, loyalty, and environmental factors. Veloso et al. (2021) discussed transport services from a social responsibility perspective, while Nilsson et al. (2025) examined environmental attitudes in service evaluation. This literature supports testing perceived sustainability, although the constructs and contexts are not entirely the same.

Passenger Satisfaction and Loyalty

Satisfaction is an evaluation of the service experience against users' expectations (Chen, 2008). This study covers satisfaction with the service, the product, and the price. Loyalty refers to a commitment to repeated use and a positive attitude toward the provider (Oliver, 1999; Dick & Basu, 1994), measured through reuse, recommendation, trust, and emotional attachment. The loyalty construct thus comprises self-reported intentions and attitudes, not actual travel records (van Lierop et al., 2018).

Hypothesis Development

Service experiences that meet expectations are associated with passenger satisfaction (van Lierop & El-Geneidy, 2016; Wan et al., 2016). Perceived economic, social, and environmental benefits can also add value to a trip. On this basis, the study proposes the following hypotheses.

H1: Service quality has a positive effect on passenger satisfaction.

H2: Perceived sustainability has a positive effect on passenger satisfaction.

Reliable and safe service gives passengers a reason to keep using the bus (Nguyen-Phuoc et al., 2021). Perceived sustainability benefits can also support users'

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preference for public transport. Both direct relationships are tested through the following hypotheses.

H3: Service quality has a positive effect on passenger loyalty.

H4: Perceived sustainability has a positive effect on passenger loyalty.

Satisfied passengers tend to intend to reuse and recommend the service (van Lierop et al., 2018; Kawabata et al., 2020).

H5: Passenger satisfaction has a positive effect on passenger loyalty.

Satisfaction can channel the relationship between both antecedents and loyalty. Differences in mediation across studies (de Oña, 2021) motivate testing the following two paths.

H6: Passenger satisfaction mediates the effect of service quality on passenger loyalty.

H7: Passenger satisfaction mediates the effect of perceived sustainability on passenger loyalty.

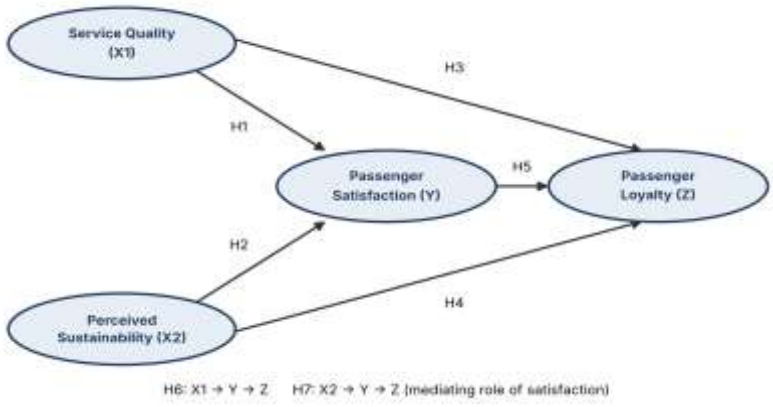


Figure 1. Conceptual research model

RESEARCH METHOD

Design, Population, and Sample

The study used a quantitative cross-sectional survey conducted in 2021 among Transjakarta passengers in West, East, South, North, and Central Jakarta. Respondents were selected through convenience sampling at bus stops, from

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passengers who were waiting or had just arrived and were willing to complete the questionnaire. Nonprobability selection limits the representativeness of the sample.

Of the 300 questionnaires distributed, 260 were complete and eligible for analysis (86.7%). The ratio of sample size to the 39 indicators is 6.7:1. This ratio is an initial guideline (Hair et al., 2019), not evidence of adequate statistical power. The source manuscript does not specify the survey dates, the distribution of respondents by stop, respondent profiles, or the procedure for handling incomplete data.

Variable Measurement

The questionnaire used a five-point Likert scale, from strongly disagree (1) to strongly agree (5). The model contains two exogenous constructs, satisfaction as the mediator, and loyalty as the endogenous construct. Table 1 summarizes the dimensions and the number of indicators. The item wording and the instrument adaptation procedure are not available in the source manuscript.

Table 1. Variables, dimensions, and number of indicators

Variable	Role in the model	Dimensions	Number of indicators
Service quality (X1)	Exogenous	Reliability, empathy, tangibles, assurance, responsiveness	13 (X1.1–X1.13)
Perceived sustainability (X2)	Exogenous	Economic, social, environmental	9 (X2.1–X2.9)
Passenger satisfaction (Y)	Mediator	Service quality, product quality, price quality	9 (Y.1–Y.9)
Passenger loyalty (Z)	Endogenous	Reuse, recommendation, trust, emotional attachment	8 (Z.1–Z.8)
Total			39

Source: Research data (2021)

Data Analysis Technique

The analysis used CB-SEM with LISREL 8.80. Evaluation of the measurement model covered error variances, factor loadings, construct reliability

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(CR), and average variance extracted (AVE). The criteria for convergent validity are AVE ≥ 0.50 and reliability CR ≥ 0.70 (Fornell & Larcker, 1981; Hair et al., 2019):

$$CR = (\Sigma\lambda)^2 / [(\Sigma\lambda)^2 + \Sigma\delta] \qquad AVE = \Sigma\lambda^2 / (\Sigma\lambda^2 + \Sigma\delta)$$

λ is the standardized factor loading and δ is the indicator error variance. Model fit was evaluated jointly through χ^2/df, RMSEA, SRMR, and incremental indices (Hair et al., 2019; Hu & Bentler, 1999). Index thresholds serve as guidelines; meeting several indices does not negate misfit on other indices.

Direct relationships were assessed using the reported t values, with |t| > 1.96 as the criterion for α = 5%. Indirect effects were computed as ab. To check arithmetic consistency, the Sobel (1982) approach uses the following formula:

$$z = ab / \sqrt{(b^2 \cdot SE_a^2 + a^2 \cdot SE_b^2)}$$

a links the antecedent to satisfaction, b links satisfaction to loyalty, and SE denotes the standard error. This test requires coefficients and standard errors on the same scale. Because the source manuscript mixes standardized β values with SEs whose scale is not explained, the Sobel calculation here is indicative. The proportion of the indirect effect is summarized as:

$$VAF = ab / (ab + c')$$

The classification of mediation follows the direction and significance of the direct and indirect effects (Zhao et al., 2010). VAF summarizes only the proportion of effects within the model, not a percentage of passengers or evidence of causation. Bootstrapping the indirect effect is more appropriate for further analysis because the distribution of the product of coefficients may be non-normal (Preacher & Hayes, 2008).

RESULTS

Measurement Model Evaluation

The source manuscript reports no negative error variances and factor loadings of 0.75–0.89. Table 2 presents the available summary. The range of factor loadings supports a preliminary check of convergent validity but does not prove separation between constructs.

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Table 2. Factor loadings, construct reliability, and average variance extracted

Construct	Number of indicators	λ range	Σλ	Σδ	CR	AVE
Service quality (X1)	13	0.82–0.89	11.32	3.12	0.98	0.76
Perceived sustainability (X2)	9	0.75–0.87	7.41	2.90	0.95	0.68
Passenger satisfaction (Y)	9	0.77–0.83	7.11	3.39	0.94	0.62
Passenger loyalty (Z)	8	0.76–0.89	6.67	2.41	0.95	0.70

Source: Estimate summary in the source manuscript; 2021 data. AVE is retained as reported; individual factor loadings and $\Sigma\lambda^2$ are not available for full verification.

CR of 0.94–0.98 and reported AVE of 0.62–0.76 meet the criteria for convergence and internal consistency. High CR values also need to be examined for possible item redundancy. The construct correlation matrix and discriminant validity results are not available, so the separation of service quality, satisfaction, and sustainability cannot yet be confirmed.

Model Fit

Table 3 shows mixed model fit. χ^2 = 1,714.13 (df = 664; $p < 0.001$) rejects exact fit, while χ^2/df = 2.58, RMSEA = 0.078, and SRMR = 0.060 meet the guidelines used. NFI, NNFI, CFI, IFI, and RFI range from 0.97 to 0.99. However, GFI = 0.75, AGFI = 0.70, and CN = 116.63 indicate limitations in fit. The model can be discussed with caution; high incremental indices are not sufficient to declare the whole model validated.

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Table 3. Goodness-of-fit test results

Fit measure	Required threshold	Result	Remarks
χ^2 (df = 664); p	Small; p ≥ 0.05	1,714.13; < 0.001	Exact fit rejected
χ^2/df	≤ 3.00	2.58	Good fit
NCP (90% interval)	Small; narrow interval	1,050.13 (931.62–1,176.29)	Descriptive
RMSEA	≤ 0.08	0.078	Good fit
ECVI	Close to saturated ECVI	M = 7.51; S = 6.02; I = 279.80	M > S; M < I
NFI	≥ 0.90	0.98	Good fit
NNFI	≥ 0.90	0.98	Good fit
CFI	≥ 0.90	0.99	Good fit
IFI	≥ 0.90	0.99	Good fit
RFI	≥ 0.90	0.97	Good fit
CN	≥ 200	116.63	Unfit
SRMR	≤ 0.08	0.060	Good fit
GFI	Close to 1	0.75	Low
AGFI	Close to 1	0.70	Low

Source: Processed data (2021); χ^2/df is calculated from the χ^2 value and degrees of freedom. M = model, S = saturated, I = independence.

Structural Model and Direct Effect Testing

The following equations present the standardized coefficients reported in the source manuscript:

$$Y = 0.49\ X1 + 0.46\ X2; \quad R^2 = 0.85$$

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$Z = 0.45\ Y + 0.27\ X1 + 0.21\ X2;\quad R^2 = 0.79$

where X1 = service quality, X2 = perceived sustainability, Y = passenger satisfaction, and Z = passenger loyalty.

The model explains 85% of the variance in satisfaction and 79% of the variance in loyalty in the sample. The remaining variance cannot automatically be attributed solely to omitted variables, because it may also include measurement and specification error. Figure 2 and Table 4 summarize the reported estimation results.

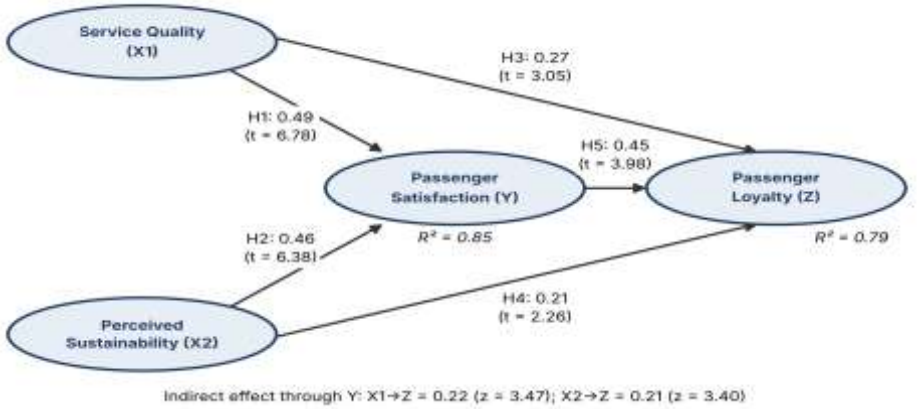


Figure 2. Estimated structural model (path coefficients and t values)

Table 4. Direct effect test results

Hypothesis	Path	Coefficient (β)	Standard error	t value	Decision
H1	Service quality → Satisfaction	0.49	0.075	6.78	Accepted
H2	Perceived sustainability → Satisfaction	0.46	0.075	6.38	Accepted
H3	Service quality → Loyalty	0.27	0.088	3.05	Accepted
H4	Perceived sustainability → Loyalty	0.21	0.091	2.26	Accepted
H5	Satisfaction → Loyalty	0.45	0.110	3.98	Accepted

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Source: Estimate summary from the source manuscript. β and t are retained as reported. The reported SE does not always yield t = β/SE; the type of standardization and the original output need to be confirmed.

The reported t values support H1–H5 at α = 5%. Based on β, the largest relationship with satisfaction is that of service quality (0.49), followed by sustainability (0.46). Satisfaction has the largest coefficient on loyalty (0.45). Differences in magnitude among the coefficients have not been tested, so they cannot be declared statistically different.

Indirect Effect Testing

Multiplying the standardized coefficients yields indirect effects of 0.2205 for service quality and 0.2070 for sustainability. Using the SEs listed in Table 4, the Sobel calculation yields z ≈ 3.47 and 3.40. These figures are only a conditional arithmetic check, not a re-test from raw data. Because the scale of the SE has not been confirmed, H6–H7 cannot yet be decided definitively.

Table 5. Indirect effect and total effect test results

Code	Path	Direct effect (c')	Indirect effect (ab)	Sobel SE	z	Total effect	VAF	Mediation type
H6	Service quality → Satisfaction → Loyalty	0.270	0.221	0.064	3.47	0.491	44.95%	Complementary (indicative)
H7	Perceived sustainability → Satisfaction → Loyalty	0.210	0.207	0.061	3.40	0.417	49.64%	Complementary (indicative)

Source: Calculated from the rounded figures in Table 4. Effects and VAF are descriptive; the Sobel z is indicative and requires the coefficient scale to match that of the SE. Bootstrap confidence intervals are not available.

The descriptive total effects are 0.4905 for service quality and 0.4170 for sustainability. The VAF values are 44.95% and 49.64%, respectively. The direction of the direct and indirect effects is consistent with complementary mediation. Establishing the significance of mediation still requires confirmation from the original output or re-estimation with bootstrapping.

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DISCUSSION

Service Quality and Perceived Sustainability as Shapers of Satisfaction

The relationship between service quality and satisfaction is consistent with the public transport literature (van Lierop & El-Geneidy, 2016; Wan et al., 2016). Schedule reliability, travel information, and safety are relevant operational contexts. However, the aggregate construct coefficient does not identify which attributes have the greatest impact; attribute priorities require additional analysis.

The coefficient of sustainability on satisfaction (0.46) is close to that of service quality (0.49), but the difference has not been tested. This pattern suggests that perceived economic, social, and environmental benefits deserve consideration alongside the service experience. Comparisons with Veloso et al. (2021) and Nilsson et al. (2025) need to take into account differences in instruments and user contexts.

Loyalty Formation: Direct Paths and Paths Through Satisfaction

About 45% of the total relationship of service quality with loyalty, and 50% of that of sustainability, runs through the path via satisfaction. This pattern differs from the full mediation reported by de Oña (2021) and is closer to models that retain direct relationships (Nguyen-Phuoc et al., 2021). However, this is a comparison of patterns, not evidence of causal differences between regions.

Limited travel alternatives may help explain why passengers keep using the bus when they are less satisfied. Sun and Duan (2019) distinguish the behavioral and attitudinal dimensions of loyalty. This study did not measure the availability of alternatives or dependence on public transport, so it cannot yet identify spurious loyalty. Changes in loyalty during the pandemic in other contexts (Esmailpour et al., 2022) also cannot be directly generalized to Jakarta.

Satisfaction has the largest direct coefficient on loyalty in this model. This result is consistent with the temporal relationships examined by Kawabata et al. (2020), but a single-time survey cannot determine whether satisfaction precedes loyalty or the reverse.

Sustainability as an Emerging Driver of Loyalty

Sustainability has a direct coefficient of 0.21 and an indirect coefficient of 0.207. The two are almost equal in size; this result does not support the claim that sustainability works mainly through satisfaction. The study also cannot determine whether passengers place more emphasis on economic, social, or environmental benefits.

Operators may consider communicating environmental benefits and making verifiable access improvements (Nilsson et al., 2025). The effectiveness of these

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measures needs to be evaluated through operational indicators and follow-up surveys, because this model does not measure behavioral change after an intervention.

RESEARCH IMPLICATIONS

Theoretical Implications

This supplementary analysis positions satisfaction as a path that may connect service quality and sustainability with loyalty. Its contribution lies in mapping direct and indirect effects within a single BRT model. High R^2 values do not prove that the constructs are complementary or that a particular affective mechanism operates. Measurement overlap and common method bias may also inflate the relationships, so discriminant validity and alternative models need to be tested.

Managerial Implications

The results give operators an initial direction, with four evaluation priorities.

- Improve schedule reliability, information accuracy, peak-hour capacity, and safety based on complaints and operational data. This aggregate model has not established the order of impact of each attribute.
- Deliver sustainability benefits through inclusive access, affordability, and measurable emission reductions. Distinguish passenger perceptions from actual environmental achievements.
- Monitor satisfaction together with actual reuse on a regular basis. Combining surveys with trip records can test whether changes in satisfaction precede changes in behavior.
- Distinguish users who choose the bus from users who depend on it. Information on modal alternatives is needed before concluding that repeated use indicates attitudinal loyalty.

Limitations and Directions for Further Research

Convenience sampling limits generalizability, while the cross-sectional design limits causal inference. The 2021 data also reflect the pandemic context. Respondent profiles, item wording, the estimator, normality checks, and ethical procedures are not detailed in the source, so they cannot be added as facts. The analysis has not controlled for trip characteristics or common method bias. CR and AVE alone do not prove discriminant validity. The absolute fit of the model is limited, and the scale of the SE is unclear. Further research should examine the LISREL output, test alternative measurement models, compute bootstrap intervals with the

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appropriate coefficients and SEs, and replicate the results on new samples. Because the data have been used in an earlier publication, the additional contribution and the suitability of the study under overlapping-publication policy should be evaluated by the authors and the journal.

CONCLUSION

In a 2021 sample of 260 Transjakarta passengers, service quality and perceived sustainability were positively associated with satisfaction and loyalty. The products of the standardized coefficients show indirect paths through satisfaction of 0.221 and 0.207, or about 45% and 50% of the respective total effects. This pattern is consistent with complementary partial mediation, but the certainty of the inference requires confirmation of the estimation scale and re-testing. The findings support evaluating service experience and perceived sustainability benefits together. The results do not prove causation, actual behavioral change, or representativeness of all passengers.

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