Journal of Business, Social and Technology
Volume 7, Issue 5, 2823-2833
e_ISSN: 2807-6362
https://bustechno.polteksci.ac.id/index.php/jbt/index
DOI: doi.org/10.59261/bustechno.v7i5.854

Travel Cost, Distance, and Accessibility in Talaud Islands Transportation Mode Choice

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Article Info:

Article history:
Received: September 22, 2026
Revised: October 20, 2026
Accepted: October 21, 2026
Available Online: November 09, 2026

Keywords:
Archipelagic Transportation;
Inter-Island Connectivity;
Structural Equation Modeling;
Talaud Islands;
Transportation Mode Choice;
Travel Behavior

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Abstract

Background: Transportation mode choice in archipelagic regions is shaped by geographical constraints, limited connectivity, and accessibility challenges. However, the relationships among travel cost, distance, and transportation-related perceptions remain insufficiently understood in remote island settings.
Objective: This study examines transportation mode preferences and the relationships among six latent constructs associated with perceived transportation choices in Talaud Islands Regency, Indonesia.
Methods: A quantitative cross-sectional approach was employed, using questionnaires distributed online and in person to 280 transportation users. Six latent constructs were measured using five-point Likert scales, and the data were analyzed using structural equation modeling (SEM) with AMOS version 20.
Results: Speedboats were the most frequently used transportation mode (33%), followed by DAMRI buses (30%) and taxis (22%), while 41% of respondents did not own a motorized vehicle. The model demonstrated favorable approximate fit indices (comparative fit index [CFI] = 0.988; Tucker–Lewis index [TLI] = 0.987; root mean square error of approximation [RMSEA] = 0.027), although the chi-square test indicated a statistically significant departure from exact fit (p = 0.004). The reported path coefficients indicated associations between travel distance and accessibility (1.04), travel cost and vehicle condition (0.44), and accessibility and conventional transportation (0.41). However, incomplete parameter diagnostics limited the interpretation of these estimates and the strength of the statistical inferences that could be drawn.
Conclusion: Findings highlight relevance of geographical constraints, transportation accessibility, and vehicle conditions in understanding transportation-related perceptions in archipelagic regions. Further research using representative sampling and comprehensive model validation is necessary to support evidence-based transportation planning.

To cite this article: Lefrandt, L. I. R., Kumaat, M., & Mandagi, A. T. (2026). Travel cost, distance, and accessibility in Talaud Islands transportation mode choice. *Journal of Business, Social and Technology, 7*(5), 2823–2833. https://doi.org/10.59261/bustechno.v7i5.854

INTRODUCTION

Transportation plays a fundamental role in supporting economic development, social interaction, and regional connectivity by facilitating the movement of people, goods, and services. Beyond providing mobility, transportation constitutes an integrated system involving infrastructure, service delivery, institutional coordination, and public policy, all of which influence regional accessibility and development opportunities (Andriansyah, 2015; Gunawan, 2026) . An

effective transportation system improves access to employment, education, healthcare, and commercial activities while strengthening economic integration between regions. Conversely, inadequate infrastructure, limited service availability, and poor connectivity can increase travel burdens and reinforce geographical disparities, particularly in remote communities. These challenges are more pronounced in archipelagic regions, where geographical fragmentation necessitates coordination between land-based and maritime transportation networks. Therefore, understanding transportation systems in geographically dispersed territories is essential for identifying mobility constraints, improving regional connectivity, and developing transportation planning strategies that address the specific accessibility needs of island communities.

Transportation mode choice is a fundamental aspect of transportation planning because it reflects how individuals evaluate available alternatives based on their mobility needs, socioeconomic characteristics, and perceptions of service quality. Travel demand arises from daily activities, including employment, education, healthcare, and economic participation, which influence individual travel patterns and transportation preferences (Priatna, 2023; Tamin, 2008) . Mode choice is influenced by interactions among socioeconomic factors, such as income, age, gender, education, and occupation, and transportation-related characteristics, including travel cost, distance, accessibility, reliability, and vehicle condition (Mappangara & Palippui, 2023; Miro, 2008) . These factors become particularly important in regions where transportation alternatives are limited and mobility depends on interconnected land-based and maritime services. In archipelagic areas, geographical separation and variations in service availability may further influence how travelers evaluate transportation options. Understanding these relationships provides a conceptual foundation for examining transportation preferences and identifying accessibility challenges within geographically fragmented transportation networks.

These challenges are particularly pronounced in remote and archipelagic regions of developing countries. Geographic isolation constrains the development and maintenance of transportation infrastructure, thereby limiting the range of available transportation modes (Noman et al., 2024) . When transportation options are limited, changes in fare policies or the cancellation of a single route can restrict entire communities' access to markets, healthcare, and education. Understanding the factors influencing transportation mode choice in such settings is therefore not merely an academic exercise; it also informs policy decisions that directly affect people's daily lives. Empirical evidence from Maluku illustrates the extent of the accessibility challenges: the average distance traveled to reach hospitals was 56.19 km by land and 73.09 km via routes combining land and water transportation (Leosari et al., 2023) . These findings provide contextual evidence from Maluku and should not be interpreted as observations from Talaud Islands Regency.

Talaud Islands Regency illustrates these challenges. Located at the northern edge of North Sulawesi Province, with Melonguane as its capital, the regency encompasses approximately 37,800 km^2 of sea and 1,251 km^2 of land. Its population of 101,140 Talaud (2025) is distributed across multiple islands, many of which can be reached only by boat. Population growth, particularly around government offices, schools, hospitals, and commercial centers, combined with limited land-based transportation infrastructure, places sustained pressure on the regional transportation system.

Residents of Talaud face transportation conditions that differ substantially from those experienced by travelers on the mainland. Several transportation modes coexist, including DAMRI public buses, taxis, motorized three-wheeled vehicles known as bentors, speedboats, and private vehicles; however, no single mode meets all transportation needs. Travelers evaluate factors such as reliability, safety, comfort, and cost when selecting a mode, and many do not own private vehicles (Supit et al., 2019; Rizal et al. 2024). This interaction between constrained transportation supply and diverse travel demand makes Talaud a valuable case for examining transportation mode choice behavior.

International studies illustrate why findings from mainland transportation systems require contextual interpretation. Devika et al. (2020) and Raghu et al. (2025) identified attitudes as an important factor influencing public transportation use intentions in India, while Fan et al. (2024) incorporated perceptions of terrain into a structural equation modeling (SEM)-based model in Lanzhou, China. Hadiuzzaman et al. (2019) and Ahmed et al. (2025) examined the

relationships between trip chaining and transportation mode choice in a developing-country context. These studies address behavioral or spatial constraints within terrestrial transportation networks; however, they do not directly capture the dependence on inter-island crossings that characterizes geographically dispersed archipelagos. Their findings therefore motivate an examination of the role of geographic context rather than the direct transfer of estimated effect sizes to Talaud.

Indonesian research provides complementary evidence. Supit et al. (2019) and Rizal et al. (2024) examined online transportation mode choice in Talaud, while Ardi et al. (2024) demonstrated that intentions to use public transportation in Jakarta vary across generations. Lefrandt & Punuhsingon (2024) modeled the relationships of travel cost, travel time, vehicle condition, and comfort with transportation mode choice in mainland Bitung, excluding its surrounding islands. Mafrisal et al. (2024) examined inter-island transportation performance in Makassar, while Leosari et al. (2023) assessed healthcare accessibility in Maluku. The former studies focus on traveler preferences and behavioral factors, whereas the latter emphasize service performance and spatial accessibility. Neither research focus, considered independently, establishes how travel cost, distance, accessibility, and perceptions of vehicle condition interact in shaping transportation mode choice in Talaud.

The research gap concerns the relationships among perceived transportation attributes and mode choice within geographically discontinuous land and maritime transportation networks. In an archipelagic setting, the implications of distance may depend not only on the distance traveled but also on the availability of access points, connecting services, and inter-island crossings. The present model therefore examines the relationships of travel cost and distance with perceived vehicle condition and mode accessibility, as well as the relationships of these constructs with conventional and private transportation modes. Its theoretical contribution lies in providing a context-specific examination of these interconnected perceptions rather than proposing a new causal theory or a predictive model of observed individual transportation choices.

This study has two objectives: to describe travelers and their transportation mode preferences in Talaud Islands Regency and to examine the relationships among transportation-related latent constructs using structural equation modeling (SEM). Simultaneous estimation enables the model to account for relationships among multiple constructs and, where appropriately specified, measurement error in the latent variables. The findings are interpreted as exploratory associations within the surveyed sample. They can help identify issues relevant to transportation service planning and guide subsequent model validation; however, they cannot, on their own, establish population-wide causal effects.

METHOD

Fieldwork took place in Talaud Islands Regency, North Sulawesi Province, Indonesia. Primary data were collected over a seven-day period in the regency. The regency comprises scattered islands connected by sea, where both land-based transportation modes (buses, taxis, *bentor* [motorized three-wheeled taxis], and private vehicles) and water-based transportation modes (speedboats) operate. This geographical setting makes the regency relevant for examining transportation mode choice in an archipelagic context.

Online questionnaires were circulated through social media, while paper questionnaires were distributed directly within the study area, yielding 280 usable responses from transportation users. No sampling frame, random selection procedure, or selection probabilities were documented; therefore, recruitment was treated as nonprobability participation through the two reported channels. Online recruitment may have favored digitally connected and younger users, whereas direct distribution depended on the individuals accessible during fieldwork. Combining the two channels broadened access to participation but did not eliminate selection bias. Channel-specific response counts and nonresponse data were unavailable.

The initial sample-planning procedure referred to the Slovin formula (Sugiyono, 2011, 2022) :

$$n = N / (1 + Ne^2) \quad (1)$$

where (N) represents the target population, (n) the planned sample size, and (e) the nominal error tolerance, initially set at 0.1. The value of (N) used in the sample-planning

calculation was not documented. Substituting the reported resident population of 101,140 into the formula would yield a planned sample size of approximately 100, rather than 280. Furthermore, the resident population does not necessarily correspond to the target population of transportation users. Accordingly, the 280 cases are reported as the achieved number of usable responses, rather than as a verified, Slovin-based representative sample. A margin of error based on probability sampling cannot be assigned to the recruitment procedure described.

Six latent variables were specified: two exogenous variables and four endogenous variables. The exogenous variables were Travel Cost (X1), measured using five indicators (BP1–BP5), and Travel Distance (X2), measured using five indicators (JT1–JT5). The endogenous variables were Vehicle Condition (Y1, indicators KK1–KK5), Ease of Mode Access (Y2, indicators KMM1–KMM5), Conventional Transportation (Y3, indicators TK1–TK5), and Private Vehicle (Y4, indicators KP1–KP5). Each indicator was measured using a five-point Likert scale ranging from Strongly Disagree (1) to Strongly Agree (5), following Sugiyono (2017) and Sugiyono (2022) .

Structural equation modeling (SEM) was used to estimate the measurement and structural components of the six interconnected latent constructs while accounting for measurement error (Lefrandt, 2023) . AMOS version 20 supports covariance-based SEM and the global model-fit indices reported in this study. Its use was therefore appropriate for evaluating the specified covariance structure rather than primarily maximizing predictive variance. This justification explains the rationale for selecting AMOS but does not establish its superiority over alternative software or variance-based approaches. SPSS was used for data processing. However, the estimation method, treatment of missing data, distributional diagnostics, and measures of parameter uncertainty were not documented in the available results, thereby limiting reproducibility (Byon, 2024; Schreiber, 2017) .

The modeling procedure followed seven standard steps: (1) theoretical model development; (2) path diagram construction; (3) translation of the diagrams into measurement and structural equations; (4) selection of the input matrix and estimation method; (5) assessment of model identification; (6) evaluation of goodness of fit; and (7) interpretation of the results and, where necessary, model modification (Lefrandt, 2023) .

RESULTS AND DISCUSSION

Results

Respondent characteristics

Of the 280 respondents, 55% were female and 45% were male. Respondents aged 18–35 accounted for 64% of the sample, followed by those aged 36–45 (20%) and 46–55 (12%); the remaining 4% were either younger than 18 or older than 55. Students comprised 33% of the sample, followed by farmers (16%), private-sector employees (13%), and civil servants (11%). Smaller occupational groups included housewives (7%), laborers (6%), retirees (3%), and traders (3%). These occupational percentages total 92%, indicating that the listed categories do not account for the entire sample. Because no corresponding population distribution of transportation users is provided, the representativeness of the sample cannot be formally assessed.

Educational attainment data showed that more than half of the respondents (54%) had completed senior high school or vocational school, while 31% held a bachelor's or master's degree. Monthly income figures reflected the substantial proportion of students in the sample: 32% reported having no income, 28% earned Rp1,000,000–3,000,000, 18% earned Rp3,000,000–5,000,000, 14% earned less than Rp1,000,000, and 8% earned more than Rp5,000,000.

Regarding motorized vehicle ownership, 41% of respondents owned no motorized vehicle, 41% owned a motorcycle, 11% owned a car, 4% owned two types of vehicles, and 3% owned a *bentor*. The proportion of respondents without motorized vehicles suggests potential reliance on public or shared transportation modes within the sample. However, this finding does not establish the extent of such dependence across Talaud Islands Regency.

The most frequently used transportation modes were speedboats (33%), DAMRI buses (30%), taxis (22%), private vehicles (13%), and *bentor* (2%). Speedboats accounted for the largest share of reported mode use, underscoring the importance of maritime connections within the surveyed setting. However, because recruitment relied on nonprobability sampling and the

sample was concentrated among younger respondents and students, these percentages should not be interpreted as population-level mode shares.

Respondent response characteristics

Table 1 summarizes the mean Likert-scale scores and achievement levels for the six study variables. All six variables fall within the manuscript's designated "Very Good" category. Travel Cost has the highest mean score (4.16; 83.20%), whereas Conventional Transportation has the lowest (4.04; 80.81%). The 0.12-point difference indicates a relatively narrow range of average scores, but it does not establish the variables' relative causal importance. Without the questionnaire items and coding procedures, these mean scores cannot independently establish affordability, objectively high service quality, or behavioral effects.

Table 1
Summary of variable response characteristics

Variable	Mean Score	Achievement Level (%)	Category
Travel Cost (BP)	4.16	83.20	Very Good
Travel Distance (JT)	4.13	82.67	Very Good
Vehicle Condition (KK)	4.10	81.94	Very Good
Ease of Mode Access (KMM)	4.12	82.33	Very Good
Conventional Transportation (TK)	4.04	80.81	Very Good
Private Vehicle (KP)	4.06	81.18	Very Good

Structural equation modeling analysis
Goodness-of-Fit assessment

Table 2 presents the available global model-fit statistics. Model fit is assessed by considering the chi-square test alongside approximate fit indices and the interpretability of the parameter estimates.

Table 2
Goodness-of-Fit test results

Index	Cut-off Value	Result	Status
Probability Chi-Square	≥ 0.05	0.004	Not Fit
CMIN/DF	≤ 2.00	1.196	Fit
GFI	≥ 0.90	0.900	Fit
CFI	≥ 0.95	0.988	Fit
TLI	≥ 0.95	0.987	Fit
RFI	≥ 0.90	0.925	Fit
IFI	≥ 0.90	0.988	Fit
NFI	≥ 0.90	0.932	Fit
RMSEA	≤ 0.08	0.027	Fit

Eight of the nine reported fit indices meet the stated thresholds. However, the chi-square test yields p = 0.004, indicating that the null hypothesis of exact model fit is rejected at the 0.05 significance level. CMIN/DF = 1.196, CFI = 0.988, TLI = 0.987, and RMSEA = 0.027 indicate favorable approximate fit according to the adopted criteria. Although the chi-square test can be sensitive to sample size (Hair et al., 2014, 2022) , sample size alone does not establish the reason for the significant result. Favorable fit indices also do not resolve potential parameter anomalies or establish causal validity (S & Mohanasundaram, 2024; Stone, 2021) . The absence of the chi-square statistic, degrees of freedom, RMSEA confidence interval, and local residual diagnostics

limits further evaluation of model fit.

Structural path analysis

Figure 1 presents the supplied structural diagram. The path coefficients are reported as displayed because their standardization status cannot be verified from the accompanying estimation output. No raw data or complete AMOS parameter tables are available for re-estimation.

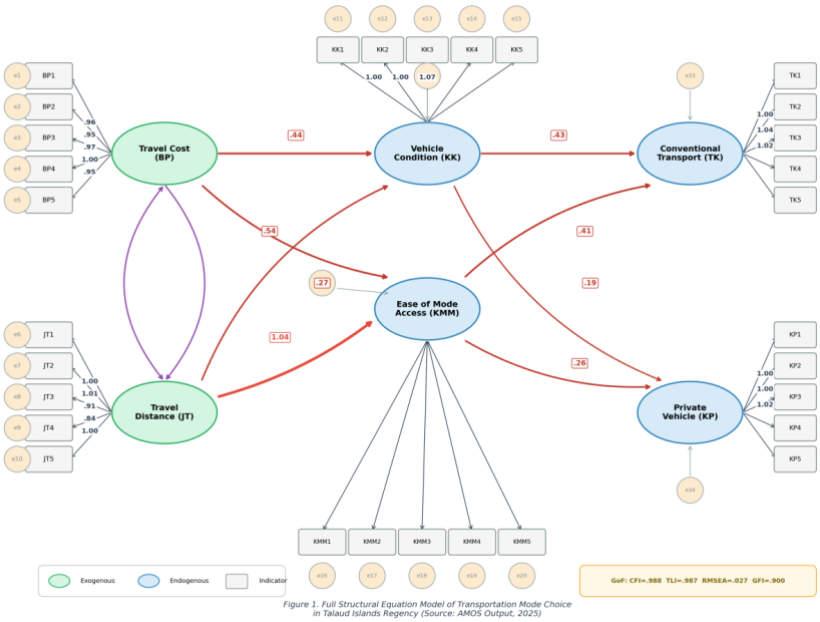


Figure 1. Full structural equation model of transportation mode choice in Talaud Islands Regency (Source: Authors' AMOS output)

Figure 1 reports a coefficient of 1.04 for the path from Travel Distance to Ease of Mode Access. Squaring this coefficient yields 1.0816; however, this value cannot be interpreted as an explained-variance proportion in a structural model involving multiple predictors. Accordingly, the coefficient is reported descriptively and is not interpreted as a causal effect or as R^2. If the coefficient is standardized, the associated residual variances and predictor correlations warrant further examination. If it is unstandardized, its magnitude depends on the measurement scales of the variables.

The coefficient for the path from Travel Cost to Vehicle Condition displayed in Figure 1 is 0.44. Although squaring this coefficient yields 0.1936, this value cannot be interpreted as the proportion of variance uniquely attributable to Travel Cost when other predictors are included in the structural equation. Furthermore, path-specific standard errors, confidence intervals, and p-values are unavailable. Therefore, the statistical significance and causal direction of this relationship cannot be established from the coefficient alone.

Figure 1 reports a coefficient of 0.41 for the relationship between Ease of Mode Access and Conventional Transportation. This coefficient is retained as presented in the structural diagram and interpreted only as a modeled association. In the absence of standard errors, confidence intervals, and p-values, its statistical significance cannot be determined. Nor does the coefficient demonstrate that improved accessibility causes travelers to shift from private vehicles to conventional transportation.

Taken together, the displayed paths identify associations for further investigation rather than establish a validated ranking of determinants. Differences in coefficient scaling, the absence of uncertainty estimates, and the limitations of interpreting the squared coefficients prevent reliable comparisons of effect magnitude. Furthermore, the cross-sectional questionnaire design limits causal interpretation.

Discussion

Speedboats were the most frequently used transportation mode among respondents (33%), highlighting the relevance of maritime connections in the surveyed setting. Studies conducted in predominantly mainland settings generally examine road-based transportation modes, including buses, motorcycles, and private cars. This difference reflects the characteristics of the available transportation networks and should inform model specification. However, the mode shares observed in this sample do not establish population-wide dependence on maritime transportation or demonstrate the effects of proposed service interventions.

The finding that 41% of respondents owned no motorized vehicle, together with the finding that 33% were students, suggests that transportation access and affordability warrant attention within the sample. Some respondents may be captive riders, defined as individuals with limited feasible transportation alternatives. Nevertheless, vehicle non-ownership alone does not establish complete dependence on public or shared transportation. The study does not include analyses of fare elasticity, willingness to pay, operator costs, or subsidies. Consequently, subsidies and cross-subsidies should be considered options for separate evaluation rather than interventions demonstrated to be effective by the present SEM.

The relationship between Travel Distance and Ease of Mode Access is relevant to the discontinuous geography of an archipelagic region. However, the displayed coefficient and its squared value cannot establish that distance is the strongest determinant of transportation mode choice. Crossing availability, weather-related disruptions, and access to terminals are plausible explanatory mechanisms, but these factors were not separately measured in the present study. Shah et al. (2023) examined latent factors influencing feeder-mode choice, supporting the consideration of access-related perceptions in a different transportation context. Their findings do not, however, confirm maritime transportation effects specific to Talaud Islands Regency.

In Bitung City, an urban, land-based setting in North Sulawesi, Lefrandt & Punuhsingon (2024) examined travel time, travel cost, vehicle condition, and comfort. Their study provides a contextual comparison but does not offer a directly comparable ranking of coefficients. Mafrisal et al. (2024) examined inter-island transportation performance in Makassar. Together, these studies motivate a distinction between terrestrial travel conditions and maritime service accessibility. However, differences in constructs, samples, and analytical designs preclude numerical claims that distance has a greater influence on transportation mode choice in Talaud Islands Regency.

The paths linking Travel Cost with Vehicle Condition and Ease of Mode Access with Conventional Transportation also require cautious interpretation. The diagram reports coefficients of 0.44 and 0.41, respectively, but does not provide the uncertainty estimates needed to assess statistical significance. These associations do not demonstrate that lower fares reduce the resources available for vehicle maintenance or that improved accessibility causes travelers to abandon private vehicles. Evaluating these proposed mechanisms would require maintenance records, operating-cost data, observed travel behavior, and consideration of competing explanations. Supit et al. (2019) and Rizal et al. (2024) provide local context for transportation mode choice but do not resolve these causal questions.

The broader literature situates cost and spatial constraints within transportation decision-making. Noman et al. (2024) and Byon (2024) investigated mode choice in urban settings, whereas Hadiuzzaman et al. (2019) and Ahmed et al. (2025) examined relationships between trip chains and transportation mode choice. Devika et al. (2020) and Fan et al. (2024) incorporated psychological and environmental perceptions into their analyses. These studies provide a broader context for interpreting the Talaud model but do not validate its unresolved parameters or establish that island-specific effects are stronger than those observed elsewhere.

Other geographically constrained settings offer complementary comparisons. Tahmid et al. (2023) investigated perceptions of mode reliability among off-campus students in Dhaka, while Bao et al. (2025) combined SEM with discrete choice analysis in rural Inner Mongolia. Leosari et al. (2023) examined land- and water-based access to health care in Maluku. These studies motivate the integration of subjective perceptions with objective route and service information. Nevertheless, their findings cannot be directly transferred to establish the magnitude of transportation benefits in Talaud Islands Regency.

The respondent profile also influences how the descriptive results should be interpreted. Respondents aged 18–35 accounted for 64% of the sample, while 32% reported having no monthly income. These characteristics may influence the types of journeys and transportation constraints represented in the questionnaire, particularly when students have limited personal financial resources and travel for education and other activities. Nevertheless, the available data do not provide cross-tabulations of age, income, vehicle ownership, and chosen transportation mode. It is therefore impossible to determine whether younger or lower-income respondents disproportionately used speedboats or conventional transportation services. Future research could examine these subgroup differences directly while also recording trip purpose and the availability of feasible transportation alternatives for each journey.

The relatively narrow range of construct means, from 4.04 for Conventional Transportation to 4.16 for Travel Cost, warrants further methodological consideration. Although all six constructs were classified as "Very Good" under the reported scoring system, agreement-based responses are not equivalent to observed levels of affordability, accessibility, or vehicle quality. The interpretation of a high score depends on the precise wording of the questionnaire items and whether negatively worded items were reverse-coded. Moreover, a concentration of responses near the upper end of the five-point scale could reduce observed variation, although a ceiling effect cannot be established without item-level response distributions. Future reporting should provide the questionnaire items, response frequencies, indicator loadings, and reliability and validity diagnostics to clarify what the latent construct scores represent.

The distinction between perceived accessibility and actual network accessibility is particularly important in an archipelagic transportation system. An individual may perceive a speedboat service as accessible because its departure point is nearby but still face substantial waiting times, infrequent departures, or uncertainty about onward connections. Conversely, a longer physical journey may remain practical when schedules and transfers are predictable. These examples illustrate potential dimensions of generalized travel burden rather than findings directly tested by the present questionnaire. Combining perception measures with origin–destination records, terminal access times, sailing timetables, cancellation logs, and actual fares would allow future analyses to distinguish distance-related constraints from service availability and journey reliability.

The reported model-fit results also indicate opportunities for methodological refinement. Favorable approximate fit indices coexist with a chi-square p-value of 0.004, while the standardization status of the 1.04 Travel Distance–Ease of Mode Access coefficient remains unclear. These results do not, by themselves, invalidate the exploratory framework, but they limit confidence in a precise ranking of structural relationships. Follow-up analyses should report whether the coefficients are standardized, inspect residual variances and potential inadmissible estimates, and provide standard errors, confidence intervals, and significance tests for each path. Assessments of convergent and discriminant validity and, where feasible, validation using an independent sample would help determine whether the proposed constructs perform consistently across different island communities. Such checks should precede any interpretation of the model as a basis for prioritizing specific transportation interventions.

The present evidence can inform assessments of access to existing transportation modes and perceived vehicle condition. However, route coverage, sailing frequency, and fare affordability should be evaluated using operational and household data before interventions are selected. The model does not estimate the benefits or costs of introducing new routes, upgrading vessels, or changing fares.

CONCLUSION

This study provides an exploratory framework for understanding transportation mode choice in Talaud Islands Regency by examining the relationships among Travel Cost, Travel Distance, Vehicle Condition, Ease of Mode Access, Conventional Transportation, and Private Vehicle. The findings highlight the relevance of geographical constraints and transportation accessibility in an archipelagic setting where land- and sea-based transportation networks coexist. The structural equation model demonstrated favorable approximate fit indices (CFI = 0.988, TLI = 0.987, and RMSEA = 0.027), although the chi-square p-value ($p = 0.004$) indicated

that exact model fit was not achieved. The reported path coefficient of 1.04 between Travel Distance and Ease of Mode Access requires cautious interpretation because its standardization status and associated parameter uncertainty remain unresolved. Similarly, the relationships between Travel Cost and Vehicle Condition (0.44) and between Ease of Mode Access and Conventional Transportation (0.41) represent modeled associations rather than statistically established causal effects. Therefore, the findings contribute to understanding transportation-related perceptions within the surveyed sample without establishing definitive rankings of determinants or population-wide conclusions.

The practical implications emphasize the importance of considering transportation accessibility, perceived vehicle condition, and geographical barriers when evaluating transportation services in Talaud Islands Regency. However, decisions concerning fare subsidies, route development, vessel improvements, and service frequency should be supported by additional operational, financial, and accessibility data rather than relying solely on the present structural model. The study's limitations include nonprobability sampling, incomplete parameter diagnostics, and a cross-sectional research design, which restrict generalizability and causal interpretation. Future research should validate the proposed model across neighboring island regions using more representative sampling procedures, complete structural parameter estimates, and additional indicators, such as transportation service frequency, weather-related disruptions, safety, and objective accessibility measures. These improvements would strengthen the empirical foundation for developing transportation policies that address the specific mobility challenges of archipelagic communities.

ACKNOWLEDGEMENT

This research was funded by the Budget Implementation Document (DIPA) of the Public Service Agency, Number: SP DIPA-139.03.2.693382/2025, Universitas Sam Ratulangi. The authors are grateful to the Rector and the Head of LPPM Universitas Sam Ratulangi for their support, and to the respondents in Talaud Islands Regency who gave their time to participate in the survey.

AUTHOR CONTRIBUTION STATEMENT

All authors contributed to the development of this research. Lucia Ingrid Regina Lefrandt, as the first author, was responsible for initiating the research concept, developing the research framework, collecting and analyzing the data, interpreting the results, and preparing the initial manuscript draft. Meike Kumaat and Agnes Tekla Mandagi contributed to the development of the research ideas, academic supervision, methodological refinement, critical review of the manuscript's content, validation of the research findings, and final revision of the manuscript. All authors have read and approved the final version of the manuscript for publication and take responsibility for the integrity, accuracy, and transparency of all aspects of the research.

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