

Route Choice Behaviour on the Nairobi Expressway, Kenya: *A Mixed-Methods Analysis of Urban Toll Road Use*

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Abstract

This study examined determinants of route choice behaviour on the Nairobi Expressway, Kenya's first major urban toll road operating alongside free alternative routes. Despite growing investment in African urban toll roads, limited empirical evidence exists on motorists' route choice behaviour in dual-network contexts. Guided by transport behaviour theory, the study assessed the influence of toll cost, entry/exit convenience, traffic flow, time savings, and road condition on motorists' decisions. A mixed-methods cross-sectional design combined questionnaire surveys (n = 690) with five key informant interviews involving Kenya National Highways Authority and Moja Expressway Company officials. Quantitative data were analysed using descriptive statistics, correlations, and multiple linear regression, while qualitative findings were analysed thematically. The regression model was statistically significant ($R^2 = 0.081$). Traffic flow and road condition significantly influenced route choice, while toll cost, time savings, and entry/exit convenience were not significant predictors. Findings suggest motorists prioritise operational reliability and infrastructure quality over direct monetary cost.

Keywords: Kenya, Nairobi Expressway, mixed-methods research, multiple linear regression, route choice behaviour, transport infrastructure, urban toll roads, operational reliability, public-private partnerships

INTRODUCTION

Urban congestion remains a persistent constraint on mobility, productivity, and quality of life in rapidly growing cities across the Global South, prompting governments to pursue both capacity-expansion and demand-management measures (Afrin & Yodo, 2020). Public-private partnership (PPP) toll roads have emerged as prominent mechanisms for expanding transport infrastructure, mobilising private capital, and accelerating project delivery (Tan & Zhao, 2019; Tsimoshynska et al., 2021). However, the effectiveness of tolled facilities depends not only on the provision of infrastructure but also on travellers' willingness to choose them over untolled alternatives operating within the same corridor. Route choice decisions are influenced by multiple factors, including perceived travel time, operational reliability, monetary cost, access convenience, and infrastructure quality (Chen et al., 2018; Wang et al., 2016; Xu et al., 2017; Zhang et al., 2017).

Despite extensive international research on route choice behaviour and toll road utilisation, empirical evidence from African urban toll roads operating alongside free alternative routes remains limited. This gap constrains context-specific guidance for planning, operations, pricing, and public acceptance within developing-city transport systems. The issue is particularly significant where the social legitimacy of PPP toll roads intersects with users' everyday experiences of service quality and operational performance (Castelblanco et al., 2022). Furthermore, recent studies increasingly suggest that operational reliability, reflected in smooth traffic flow and predictability, may influence route choice more strongly than nominal travel-time savings alone (Wang et al., 2018; Zhang et al., 2017). These findings underscore the need to examine whether similar behavioural patterns occur within African urban transport contexts.

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Commissioned in 2022, the Nairobi Expressway provides a tolled alternative to the Mombasa Road corridor and associated city routes, offering an early-operation African case for examining route choice behaviour within a dual-network system (KeNHA, 2024; Moja Expressway Company Limited, n.d.). The facility creates an opportunity to analyse how motorists trade off monetary cost against perceived service attributes such as operational reliability, time savings, access convenience, and infrastructure quality when a non-tolled substitute is readily available (Chen et al., 2018; Wang et al., 2016; Xu et al., 2017).

Guided by transport behaviour perspectives, this study evaluates the determinants of route choice behaviour on the Nairobi Expressway, focusing on five constructs: toll cost, entry/exit convenience, traffic flow (operational reliability), time savings, and road condition. The study addresses the identified evidence gap by integrating user survey data ($n = 690$) with operator perspectives obtained through key informant interviews, thereby providing mixed-methods insights into the drivers of tolled-route adoption in a developing-city context (Krosnick & Presser, 2010; Story & Tait, 2019; Tashakkori et al., 2021).

Accordingly, this study investigates the determinants of route choice behaviour on the Nairobi Expressway using a mixed-methods approach that integrates user perceptions and operator perspectives.

The study sought to:

- i) Quantify the associations between toll cost, entry/exit convenience, traffic flow, time savings, road condition, and route choice behaviour on the Nairobi Expressway (Wang et al., 2016; Zhang et al., 2017).
- ii) Identify which determinants significantly predict route choice behaviour within a multivariate framework (Chen et al., 2018; Xu et al., 2017).
- iii) Contextualise quantitative findings using operator perspectives to inform planning, operations, and policy for urban toll roads in similar contexts (Castelblanco et al., 2022; Tan & Zhao, 2019).

The hypotheses guiding the study were as follows:

H1: Perceived traffic flow (operational reliability) is positively associated with route choice behaviour (Wang et al., 2018; Zhang et al., 2017).

H2: Perceived road condition is positively associated with route choice behaviour (Xu et al., 2017).

H3: Perceived time savings is positively associated with route choice behaviour (Wang et al., 2016).

H4: Perceived toll cost is negatively associated with route choice behaviour (Wang et al., 2016).

H5: Perceived entry/exit convenience is positively associated with route choice behaviour (Chen et al., 2018).

THEORY

Theoretical Framework

This study is grounded in Random Utility Theory (RUT), which posits that travellers select routes that maximize perceived utility based on factors such as travel time, monetary cost, reliability, convenience, and comfort. In the context of toll roads, motorists evaluate trade-offs between direct toll payments and perceived service benefits, including smoother traffic flow, improved road condition, travel predictability, and access convenience. The theory provides an appropriate framework for understanding how users make route choice decisions when both tolled and untolled alternatives are available within the same transport corridor.

Route Choice Fundamentals: Time, Cost, and Reliability

Classical route choice research identifies perceived travel time, monetary cost, and travel time reliability as primary determinants of path selection in urban transport networks (Wang et al., 2016; Zhang et al., 2017). In tolled corridors, users weigh direct costs against expected service gains. Price-sensitive travellers may avoid toll roads, while others accept payment when congestion relief and travel predictability are valued more than nominal time savings (Wang et al., 2016; Wang et al., 2018). This trade-off highlights the importance of examining both average travel time and travel time variability (reliability) when assessing tolled-route uptake (Wang et al., 2018; Zhang et al., 2017).

Infrastructure Quality and Perceived Safety/Comfort

Physical road condition influences perceived comfort and safety, thereby affecting route attractiveness even where time or cost differentials are relatively small. Empirical studies associate better surface quality and maintenance standards with greater route preference, partly because of reduced vibration, noise, and perceived travel risk (Nie et al., 2018; Xu et al., 2017). For tolled facilities, consistent maintenance standards may further reinforce willingness to pay by signalling dependable service quality and operational reliability (Xu et al., 2017).

Access Geometry and Network Design

Access-point placement and ramp density influence local accessibility and may create asymmetries in perceived convenience across origins and destinations (Chen et al., 2018; Zhang, Wang, & Chen, 2017). Evidence from congestion-pricing and toll-road studies indicates that poorly aligned entry and exit locations can suppress usage among specific user groups even when corridor-level travel time savings exist (Chen et al., 2018; Garg et al., 2016). These effects are context dependent and vary according to urban form, trip patterns, and network redundancy.

Information and Behavioural Responses

Information provision, including real-time traffic updates and travel advisories, can influence perceived reliability and route choice behaviour, sometimes more strongly than static attributes such as posted toll prices (Li et al., 2019; Wang et al., 2018). This suggests that user experience is shaped not only by physical infrastructure but also by operational management and communication systems that reduce uncertainty and improve travel predictability.

Toll Roads, PPPs, and Legitimacy in Developing Contexts

International evidence suggests that PPP-delivered toll roads can expand transport capacity and mobilise infrastructure investment effectively. However, long-term public acceptance depends largely on perceived value for money and consistent service quality (Tan & Zhao, 2019; Castelblanco et al., 2022). In developing-country contexts, issues of social legitimacy, equitable access, and affordability heighten the importance of transparent operations and reliable service

delivery, which in turn influence route choice behaviour on tolled facilities (Castelblanco et al., 2022). Similar concerns have also emerged within African infrastructure and PPP discussions, where user perceptions increasingly shape acceptance of urban toll-road projects.

Regional Context and the African Evidence Gap

Although determinants such as travel time, cost, reliability, access convenience, and road condition are well documented internationally, peer-reviewed empirical evidence from African urban toll roads operating alongside free alternatives remains limited. Corridor contexts such as the Nairobi Expressway, an early-operation PPP facility with a parallel untolled substitute, provide opportunities to examine whether operational reliability and infrastructure quality outweigh direct price considerations in real-world African urban settings (KeNHA, 2024; Moja Expressway Company Limited, n.d.). This evidence gap motivates the present study's focus on perceived traffic flow (operational reliability), time savings, toll cost, entry/exit convenience, and road condition as determinants of route choice behaviour.

Conceptual Framework and Hypotheses Linkage

Drawing on transport behaviour perspectives and Random Utility Theory, the study models route choice behaviour as a function of five constructs:

- i) Toll cost (expected negative association with tolled-route use) (Wang et al., 2016).
- ii) Time savings (expected positive association) (Wang et al., 2016).
- iii) Traffic flow/reliability (expected positive association) (Wang et al., 2018; Zhang et al., 2017).
- iv) Entry/exit convenience (expected positive association) (Chen et al., 2018; Garg et al., 2016).
- v) Road condition (expected positive association through comfort and safety perceptions) (Nie et al., 2018; Xu et al., 2017).

This framework aligns with the study's multivariate specifications and guides the hypotheses tested within the Nairobi Expressway case.

Synthesis and Gap Statement

Across diverse contexts, operational reliability

and infrastructure quality increasingly emerge as decisive determinants of toll-road usage, sometimes outweighing direct monetary costs where congestion levels are severe (Wang et al., 2018; Xu et al., 2017; Zhang et al., 2017). However, empirical testing of these dynamics within African urban toll-road contexts remains limited. By analysing the Nairobi Expressway using a mixed-methods design, this study addresses that gap and evaluates whether perceived operational reliability and road condition dominate route choice behaviour within this setting (KeNHA, 2024; Moja Expressway Company Limited, n.d.; Tan & Zhao, 2019).

Figure 1 illustrates that motorists' route choice behaviour is influenced by the perceived utility derived from using either the Nairobi Expressway or alternative routes. Guided by Random Utility Theory (RUT), the framework assumes that travellers select routes that maximize benefits while minimizing costs. Toll cost is expected to negatively influence expressway usage because higher toll charges may discourage motorists from choosing the tolled facility. Conversely, time savings, improved traffic flow reliability, convenient entry and exit access, and better road condition are expected to positively influence route choice behaviour by increasing the attractiveness of the Nairobi Expressway. The framework therefore demonstrates the relationship between service

quality factors and motorists' decision-making in urban transport corridors.

RESEARCH METHODS

Research Design

The study employed a mixed-methods cross-sectional design integrating a structured questionnaire survey with key informant interviews. The quantitative strand quantified associations between candidate determinants and route choice behaviour, while the qualitative strand contextualised findings through operational and policy perspectives obtained from sector officials (Tashakkori, Johnson, & Teddlie, 2021; Story & Tait, 2019).

Study Population, Sampling Frame and Sampling Strategy

The target population comprised motorists travelling along the Nairobi Expressway corridor, including users of the tolled facility and the parallel untolled route. The sampling frame consisted of drivers encountered at selected access and egress points of the Expressway and major junctions along the parallel corridor during typical daytime operating hours.

A multi-stage sampling approach was adopted. First, high-volume locations were purposively selected to capture diverse trip patterns. Second,

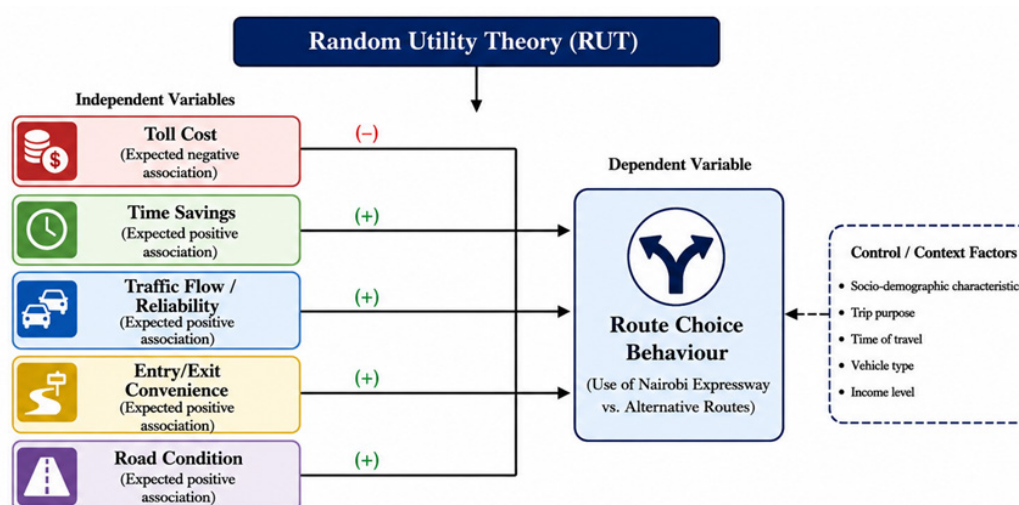


FIGURE 1

Theoretical framework showing factors affecting Nairobi Expressway route choice behaviour

Source: Author's conceptualization, 2026

time-location sampling was conducted across multiple days and time blocks to minimise temporal bias. Third, systematic intercept sampling was applied by selecting every kth eligible motorist to approximate random selection within each location. The achieved sample size was $n = 690$. This strategy balanced feasibility and heterogeneity in the absence of a complete sampling list for corridor users (Lohr, 2021; Sudman, 1976).

In addition, five key informant interviews were conducted with officials from the Kenya National Highways Authority (KeNHA) and Moja Expressway Company. The participants were selected purposively based on their operational and managerial involvement with the Expressway.

A sample data collection point at one of the exits is shown in **Figure 2**.

Measures and Instrument Development

The dependent variable was route choice behaviour, measured as the self-reported likelihood or frequency of choosing the Nairobi Expressway over the untolled alternative during study trips. Responses were captured using a Likert-type scale, where higher scores indicated greater preference for the Expressway.

The independent variables included:

- i) Toll cost (perceived affordability and value-for-money; higher scores represented more favourable perceptions).
- ii) Entry and exit point convenience (perceived accessibility of ramps relative to origins and destinations).
- iii) Traffic flow (perceived smoothness and reliability of traffic movement).
- iv) Time savings (perceived travel-time advantage relative to the untolled route).
- v) Road condition (perceived pavement quality, infrastructure condition, and travel comfort).

The measurement items were adapted from established transport behaviour and route-choice constructs and contextualised for the Nairobi Expressway corridor (Wang et al., 2016; Zhang et al., 2017; Chen et al., 2018; Xu et al., 2017). All items used consistent Likert-scale polarity, where higher scores reflected more favourable perceptions, thereby facilitating interpretation and comparison across constructs.

Pilot Testing, Reliability and Validity

The questionnaire was pre-tested with a small group of Nairobi Expressway corridor users to assess the clarity, relevance, and sequencing of the survey items. Feedback obtained during the pilot exercise was used to refine the wording and structure of the questionnaire before the main



FIGURE 2

Road side interview at Eastern Bypass Exit of the Expressway

Source: Adapted from Moja Expressway, 2026

survey.

Content validity was established through expert review involving transport planning academics and a corridor operations specialist. The experts assessed the adequacy of the questionnaire items in capturing the study constructs, including toll cost, traffic flow, time savings, entry and exit convenience, road condition, and route choice behaviour.

Construct validity was supported through expert review involving transport planning academics and a corridor operations specialist. Expected inter-construct relationships, such as the positive association between traffic flow and time-savings perceptions, further supported construct validity (Krosnick & Presser, 2010).

Data Collection Procedures

Trained research assistants conducted face-to-face intercept surveys at designated locations using a standardised administration procedure. The process included eligibility screening, confirmation of recent corridor use, and informed consent before participation.

To minimise non-response and selection bias, research teams rotated survey periods across morning peak, inter-peak, evening peak, and early evening time blocks, as well as across different collection sites. Key informant interviews were conducted using a semi-structured interview guide focusing on operations, maintenance, pricing, access management, and user experience. With participants' consent, interviews were audio-recorded and later transcribed verbatim for analysis.

Ethical Considerations

The study adhered to established ethical principles governing human-subject research, including voluntary participation, informed consent, confidentiality, anonymity, and the right of participants to withdraw at any stage without penalty. No personally identifiable information was retained in the analytical dataset.

Ethical approval for the study was obtained from the relevant University of Nairobi Ethics Review Committee and a research licence was obtained from the National Commission for Science, Technology and Innovation (NACOSTI) prior to

commencement of data collection. Permission to conduct the study was also obtained from the relevant transport authorities and organisations involved in the Nairobi Expressway corridor. All respondents participated voluntarily after being informed of the purpose of the study, and their responses were treated with strict confidentiality and used solely for academic research purposes.

Quantitative Analysis

Descriptive statistics were used to summarise measures of central tendency and dispersion for the study variables. Pearson correlation analysis was conducted to examine zero-order relationships among the variables.

Multiple linear regression analysis was used to estimate the relationship between the independent variables and route choice behaviour. The regression model was specified as follows:

$$Y = \beta_0 + \beta_1(\text{Cost}) + \beta_2(\text{Time Savings}) + \beta_3(\text{Traffic Flow}) + \beta_4(\text{Entry/Exit}) + \beta_5(\text{Road Condition}) + \varepsilon$$

Where:

- Y = Route choice behaviour
- β_0 = Constant term
- β_1 – β_5 = Regression coefficients
- ε = Error term

Ordinary Least Squares (OLS) estimation was applied with a significance level of $\alpha = 0.05$. Variables were coded such that higher scores represented more favourable perceptions. Standardised beta coefficients were reported to facilitate comparison of relative effect magnitudes across predictors.

Regression assumptions were systematically examined. Linearity was assessed using component-plus-residual plots, while homoscedasticity was evaluated through residual-versus-fitted plots and the Breusch–Pagan test. Normality of residuals was examined using Q–Q plots and the Shapiro–Wilk test for sensitivity analysis. Independence of observations was evaluated through review of the data collection structure and residual patterns by collection order.

Multicollinearity diagnostics were assessed using Variance Inflation Factors (VIF), with all values remaining within acceptable thresholds, indicating no serious multicollinearity concerns.

Where heteroscedasticity was suspected, heteroscedasticity-robust standard errors (HC-type) were additionally examined to confirm consistency of statistical inferences (Wang et al., 2016; Xu et al., 2017).

Qualitative Analysis

Qualitative interview transcripts were analysed thematically using an iterative coding process. An initial codebook was developed deductively from the interview guide themes, including operations, maintenance, pricing, access management, and user experience. Additional themes emerging from the data, such as incident response and communication of reliability, were incorporated inductively during analysis.

Coding was conducted by the lead researcher, while a second reviewer independently assessed a subset of transcripts to enhance coding consistency and credibility. Emergent themes were triangulated with quantitative findings to strengthen interpretation and overall study validity (Tashakkori et al., 2021).

Integration of Methods

The study adopted a convergent mixed-methods integration approach in which quantitative and qualitative findings were analysed independently and merged during interpretation. Areas of convergence and divergence between the two strands were examined to provide deeper explanation of the statistical findings, particularly regarding the dominance of traffic flow and road condition over toll cost and entry/exit convenience in influencing route choice behaviour (Tashakkori et al., 2021).

Limitations of the Method

The cross-sectional and intercept-based nature of the study limits causal inference and may under-represent motorists travelling outside the sampled time periods. In addition, reliance on self-reported perceptions may introduce recall and response biases.

Despite these limitations, the mixed-methods design and triangulation strategy enhanced the robustness of findings. The limitations nevertheless inform recommendations for future studies employing revealed-preference datasets, panel data, and longitudinal research designs (Story & Tait, 2019; Lohr, 2021).

Study Area

The study area for this research was the Nairobi Expressway, a major toll road located within Nairobi City County, Kenya. Commissioned in 2022, the Nairobi Expressway represents a significant addition to the city's transportation infrastructure and was developed to alleviate chronic traffic congestion, improve mobility, and facilitate faster movement of people and goods within Nairobi and along the Northern Corridor.

The Expressway plays a strategic role in improving connectivity to and from Jomo Kenyatta International Airport (JKIA), Kenya's largest airport and East Africa's major aviation hub. The project was intended to enhance transportation logistics efficiency while expanding socio-economic benefits for road users along the corridor.

The Nairobi Expressway alignment begins at Mlolongo and traverses Nairobi's Central Business District before terminating at the junction of James Gichuru Road and Waiyaki Way. The alignment follows the median strip of the Mombasa Road/Uhuru Highway/Waiyaki Way corridor (A8 Road), one of the busiest transport corridors in Kenya.

The Expressway has a total length of 27.1 kilometres, comprising approximately 18.1 kilometres of subgrade section and 9 kilometres of elevated viaduct. The facility was designed as a Class A Highway consisting primarily of a four-lane dual carriageway with an approximate width of 21.6 metres, expanding to six lanes between the Eastern Bypass and Southern Bypass sections with an approximate width of 28.6 metres.

The Nairobi Expressway was selected as the study area because it operates as a tolled urban highway running parallel to untolled alternative routes, thereby providing a suitable environment for examining motorists' route choice behaviour under varying perceptions of toll cost, traffic flow, time savings, accessibility, and road condition.

Figures 3 and 4 present the location of Nairobi within Kenya and the route map of the Nairobi Expressway, respectively.

LOCATION OF NAIROBI CITY COUNTY WITHIN KENYA

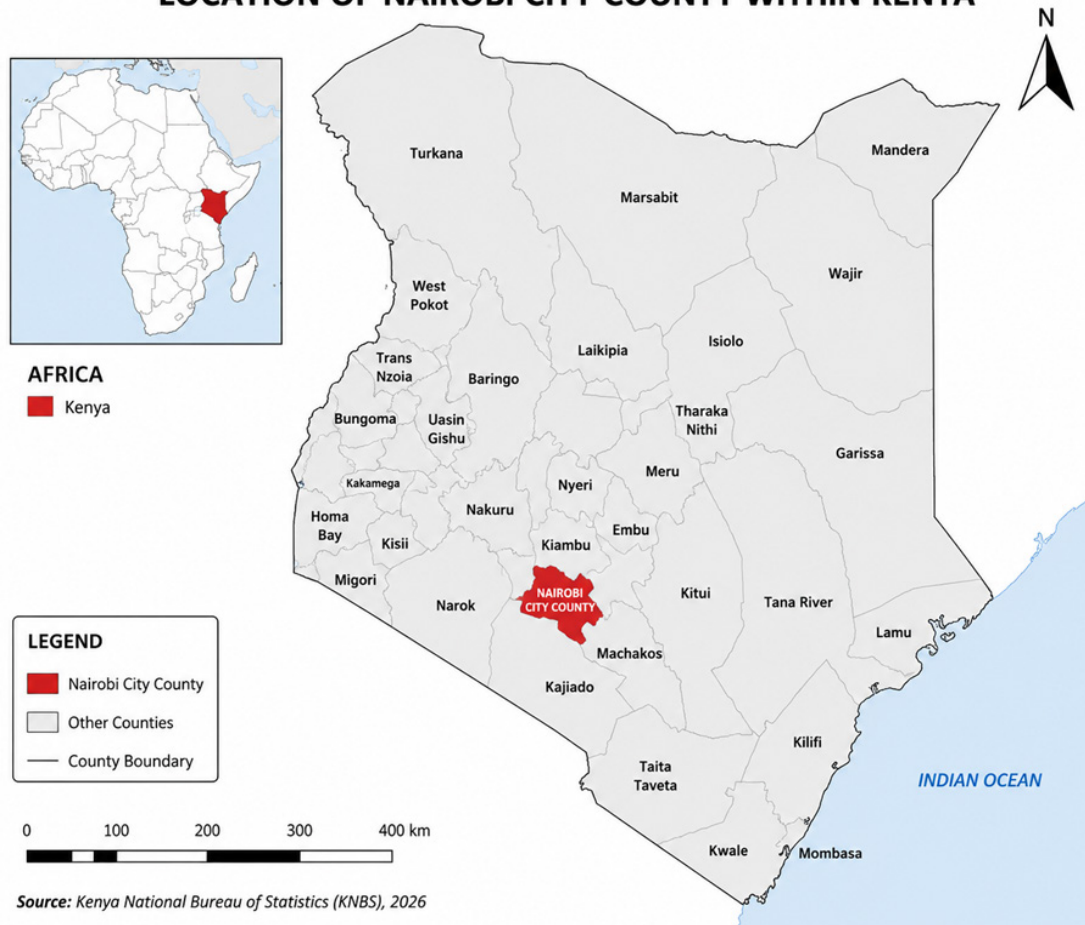


FIGURE 3

Map showing location of Nairobi in Kenya

Source: Adapted from Kenya National Bureau of Statistics (KNBS), 2026



FIGURE 4

Route Map of the Nairobi Expressway

Source: Adapted from Moja Expressway, 2026

RESULTS

Descriptive Overview

Respondents generally rated the Nairobi Expressway positively in terms of traffic flow and road condition, suggesting favourable perceptions regarding smooth traffic operations, operational reliability, and infrastructure maintenance. In contrast, perceptions relating to toll cost and entry/exit convenience were relatively mixed, indicating variations in users' views regarding affordability and the accessibility of access ramps in relation to trip origins and destinations.

The descriptive findings therefore suggest that users attach greater value to operational performance and driving comfort than to cost considerations alone. These patterns provided an initial indication of the factors likely to influence motorists' route choice behaviour along the Nairobi Expressway corridor.

Correlation Analysis

Bivariate analysis was conducted to examine the relationships between the study variables and route choice behaviour. The findings suggested that perceptions of traffic flow and road condition were positively associated with motorists' preference for the Nairobi Expressway. Respondents who perceived smoother traffic movement, greater operational reliability, and better road conditions generally demonstrated a higher likelihood of choosing the Expressway.

Perceived time savings also exhibited a positive association with route choice behaviour, although the relationship appeared less pronounced than those observed for traffic flow and road condition. In contrast, perceptions relating to toll cost and entry/exit convenience demonstrated relatively limited associations with route choice behaviour.

Overall, the observed patterns suggested that operational reliability and infrastructure quality were more closely associated with motorists' route choice decisions than cost-related or accessibility considerations. These findings provided preliminary support for the subsequent regression analysis, which identified traffic flow and road condition as the most influential predictors of route choice behaviour.

Regression Analysis

Multiple linear regression analysis was conducted to examine the influence of traffic flow, road condition, time savings, toll cost, and entry/exit convenience on route choice behaviour. The regression model was statistically significant and explained approximately 8.1% of the variation in route choice behaviour ($R^2 = 0.081$; Adjusted $R^2 = 0.075$). **Table 1** presents the standardized regression coefficients, significance levels, and relative influence of the predictor variables included in the model.

The findings indicate that traffic flow emerged as the strongest predictor of route choice behaviour, followed by road condition. Both variables demonstrated statistically significant positive effects on motorists' likelihood of choosing the Nairobi Expressway. Conversely, time savings, toll cost, and entry/exit convenience did not exhibit statistically significant effects within the regression model.

The regression findings indicate that traffic flow emerged as the strongest predictor within the model. Specifically, a one standard deviation increase in perceived traffic flow reliability was associated with an approximate 0.45 standard deviation increase in the likelihood of choosing the Nairobi Expressway, while controlling for

TABLE 1

Standardized regression coefficients for determinants of route choice behaviour

Variable	β	p-value	Significance
Traffic Flow	0.454	<0.001	Significant
Road Condition	0.151	0.046	Significant
Time Savings	0.067	0.354	Not Significant
Toll Cost	-0.013	0.725	Not Significant
Entry/Exit Convenience	-0.002	0.956	Not Significant

Source: Research data (2026)

other variables. This finding highlights the importance of operational reliability and smooth traffic movement in influencing motorists' route choice decisions.

Road condition also demonstrated a statistically significant positive relationship with route choice behaviour, although with a smaller effect magnitude compared to traffic flow. This suggests that pavement quality, ride comfort, and infrastructure maintenance contribute positively to motorists' preference for the Expressway.

Graphical Presentation of the Results

i). Regression Effects of Determinants of Route Choice Behaviour

The bar lengths in **Figure 5** represent the standardised regression coefficients β for each determinant of route choice behaviour. Longer bars indicate stronger influence on motorists' likelihood of choosing the Nairobi Expressway while controlling for other variables in the regression model. Bars closer to zero indicate relatively weaker influence.

Traffic flow recorded the largest positive regression effect $\beta = 0.454$, substantially exceeding the effects of all other determinants. This indicates that perceived traffic reliability and smooth

traffic movement exert the strongest influence on motorists' route choice behaviour within the model. Road condition demonstrated a smaller but statistically significant positive effect $\beta = 0.15$, suggesting that infrastructure quality and ride comfort also contribute positively to Expressway preference.

Time savings exhibited a relatively small positive coefficient $\beta = 0.067$, although the effect was not statistically significant. Toll cost and entry/exit convenience recorded coefficients close to zero, indicating minimal independent influence on route choice behaviour once the effects of other variables were controlled for within the regression model.

ii). Significance of Determinants

The significance indicators presented in **Figure 6** classify predictors according to their statistical significance levels within the regression model. Determinants labelled "Significant" correspond to predictors with ($p < 0.05$), while those labelled "Not Significant" correspond to predictors with ($p \geq 0.05$).

The results indicate that traffic flow and road condition were statistically significant predictors of route choice behaviour. In contrast, time savings,

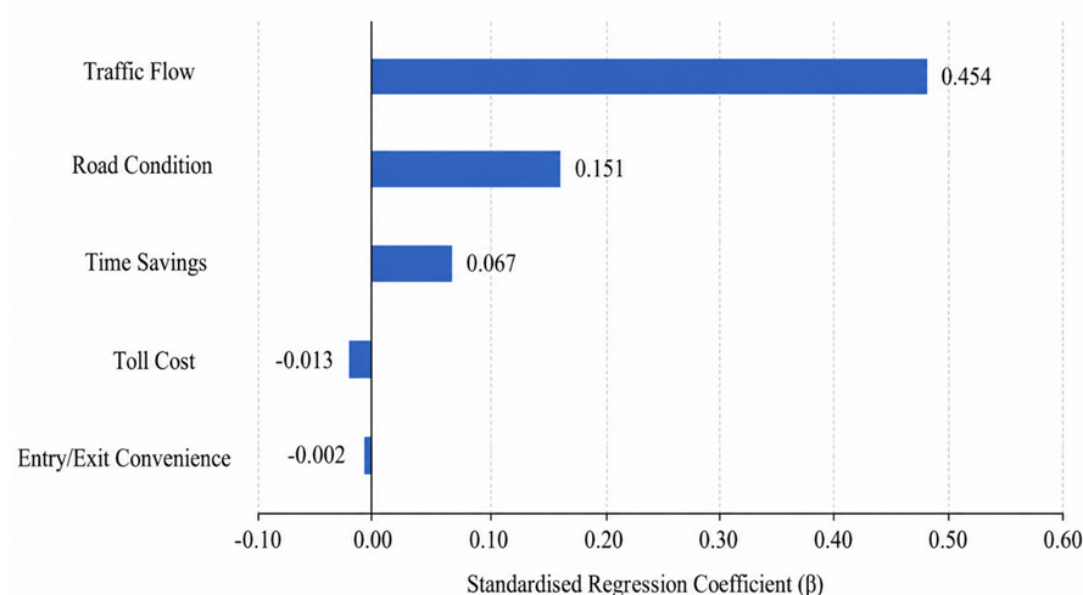


FIGURE 5

Regression effects on the study

Source: Author's analysis based on survey data (2026)

toll cost, and entry/exit convenience did not demonstrate statistically significant effects within the model. These findings are consistent with the regression coefficient results and further suggest that operational reliability and infrastructure quality are more influential determinants of Nairobi Expressway usage than monetary cost or perceived accessibility factors.

iii). Comparative Trend of Key Determinants

The graph in **Figure 7** presents the comparative mean scores for the key determinants examined in the study. Higher mean values indicate more favourable respondent perceptions regarding each determinant of route choice behaviour.

The findings indicate that traffic flow recorded the highest average perception score among respondents, followed by road condition. This suggests that motorists generally perceived the Nairobi Expressway positively in terms of operational reliability, smooth traffic movement, and infrastructure quality. These findings are consistent with the regression results, where traffic flow and road condition emerged as the strongest predictors of route choice behaviour.

Time savings recorded a moderate average score, indicating that respondents acknowledged some travel-time advantage associated with the

Expressway, although the perceived benefit was less pronounced than perceptions relating to traffic flow and road condition.

Conversely, toll cost and entry/exit convenience recorded the lowest average perception scores among the determinants. These comparatively lower ratings reflect mixed user perceptions regarding affordability and accessibility of access ramps relative to trip origins and destinations. The descriptive trends therefore suggest that motorists place greater emphasis on operational reliability and infrastructure quality than on direct monetary cost or localised accessibility considerations when choosing the Nairobi Expressway.

iv). Overall Explanatory Trend of the Model

Figure 8 presents the overall explanatory power of the regression model using the coefficient of determination R^2 and adjusted coefficient of determination R^2 and adjusted coefficient of determination (Adjusted R^2). The model produced an R^2 value of 0.081 and an adjusted R^2 value of 0.075.

The model captures meaningful, but not exhaustive, variation-consistent with behavioural outcomes influenced by additional factors (e.g., income, trip purpose, urgency, safety perceptions) not included here.

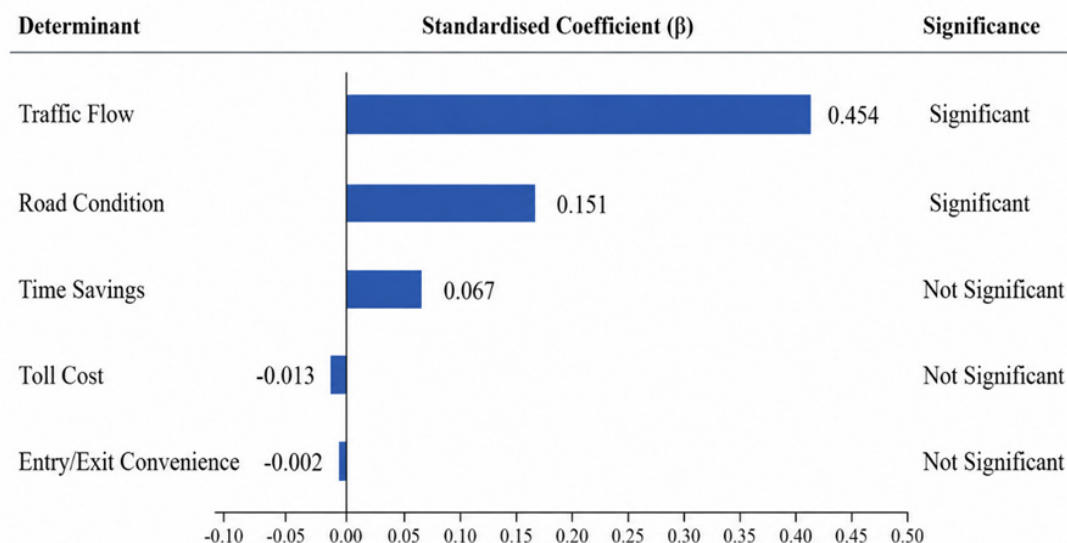
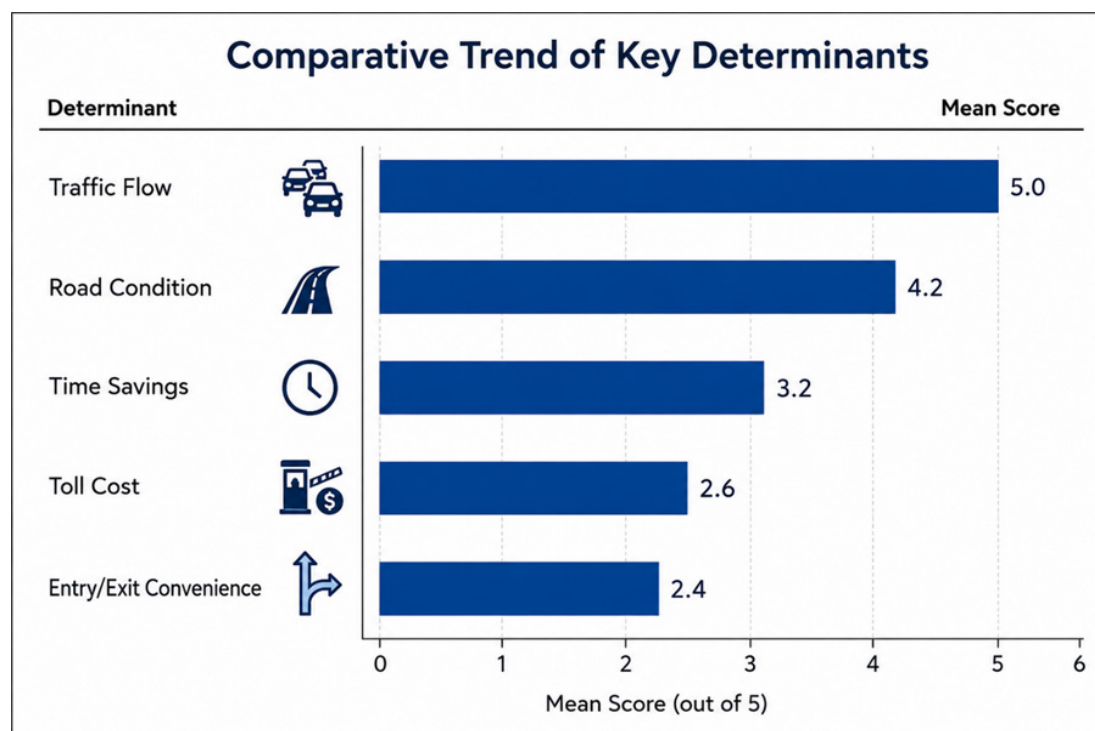


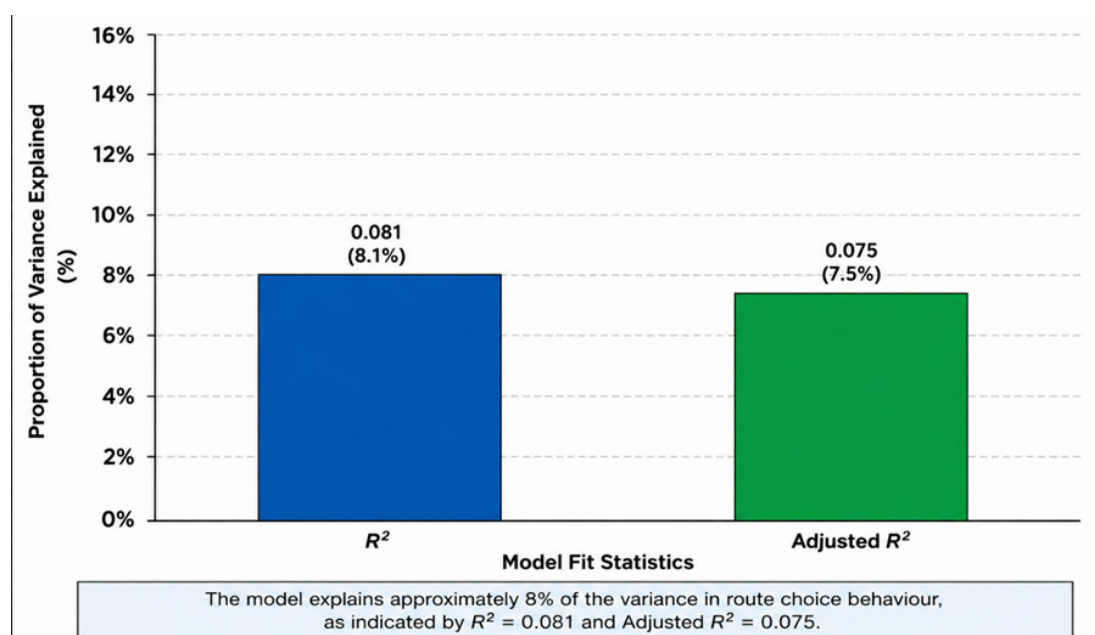
FIGURE 6

Determinants significance

Source: Author's analysis based on survey data (2026)

**FIGURE 7**

Comparative trends

Source: Author's analysis based on survey data (2026)**FIGURE 8**

Overall model

Source: Author's analysis based on survey data (2026)

v). Ranked Influence of Determinants

Figure 9 presents the determinants ranked according to the magnitude of their standardized regression coefficients (β). The ranking illustrates the relative influence of each determinant on route choice behaviour rather than statistical significance alone.

The results ranked the determinants as follows:

- * Rank 1: Traffic flow
- * Rank 2: Road condition
- * Rank 3: Time savings
- * Rank 4: Toll cost
- * Rank 5: Entry/Exit convenience

Traffic flow emerged as the most influential determinant of route choice behaviour, indicating that motorists place considerable importance on smooth and reliable traffic movement when choosing the Nairobi Expressway. Road condition ranked second, suggesting that infrastructure quality, ride comfort, and maintenance standards also contribute substantially to Expressway preference.

Time savings recorded a comparatively lower influence despite its positive association with route choice behaviour. Toll cost and entry/exit

convenience demonstrated the least influence within the model, indicating relatively limited contribution to motorists' route selection decisions compared to operational reliability and infrastructure quality.

Practical Implications from the Figures

The graphical findings present several practical implications regarding motorists' route choice behaviour along the Nairobi Expressway corridor.

i). Reliability of road infrastructure: **Figures 6, 7, and 9** consistently identify traffic flow as the strongest determinant of route choice behaviour. This suggests that operational reliability, including effective traffic management, incident response, lane control, and real-time traffic operations, plays a critical role in sustaining Expressway usage.

ii). Infrastructure quality as a service indicator: The positive influence of road condition shown in **Figures 6 and 7** indicates that visible and consistent infrastructure maintenance contributes positively to user confidence and willingness to use the tolled facility.

iii). Toll cost within a service-quality context: Although toll cost recorded relatively low favourability ratings in the descriptive findings,

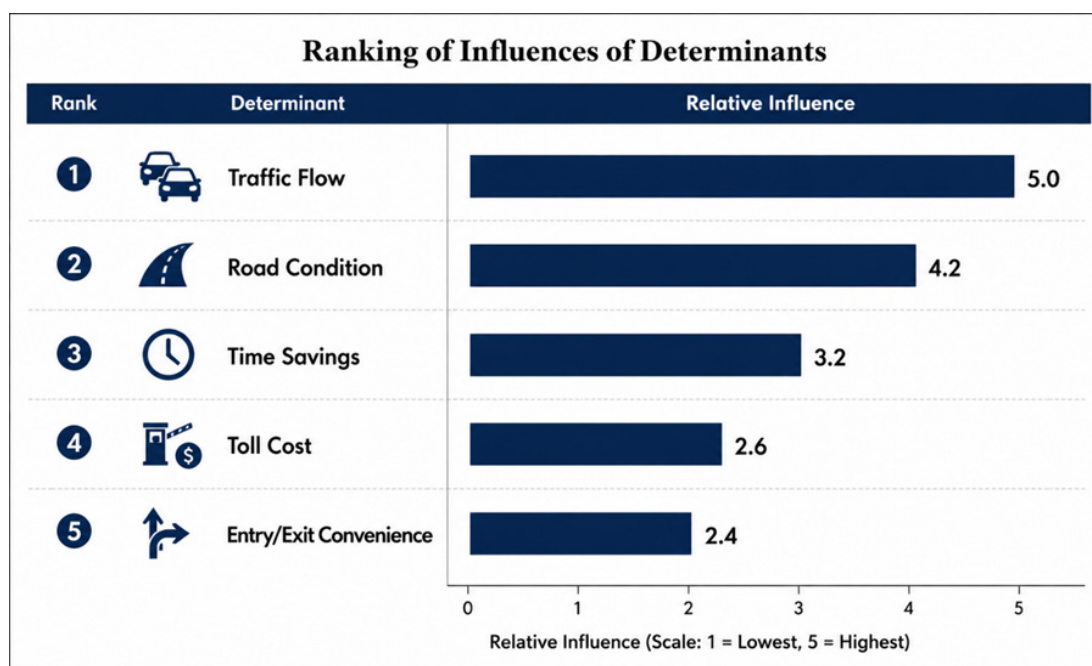


FIGURE 9

Ranking of determinants by influence

Source: Author's analysis based on survey data (2026)

its regression effect remained negligible within the multivariate model. This suggests that motorists may tolerate toll charges where reliable traffic movement and good infrastructure quality are consistently experienced.

iv). Limited corridor-level access influence: Entry/exit convenience recorded comparatively low perception scores and negligible predictive influence within the regression model. The findings therefore suggest that corridor-level route choice behaviour is currently less constrained by access configuration, although localised operational bottlenecks may still influence specific user experiences.

Qualitative Triangulation Interview Themes

The qualitative interview findings generally mirrored the quantitative patterns observed in the statistical analysis.

i). Reliability as the core service value: Interview participants consistently identified reliable traffic flow and predictable travel conditions as the primary reasons motivating motorists to choose the Nairobi Expressway. These observations aligned closely with the quantitative dominance of traffic flow within the regression model.

ii). Maintenance standards as a visible quality signal: Key informants emphasized that consistent maintenance standards reinforce public confidence in the Expressway system and support repeated usage. This finding corresponds with the positive influence of road condition observed in the quantitative analysis.

iii). Value-for-money perceptions of toll charges: Interview participants noted that motorists are generally more willing to tolerate toll charges when traffic reliability and service quality remain dependable. However, dissatisfaction with reliability may increase sensitivity to toll cost, helping explain the relatively weak and conditional role of cost within the regression results.

DISCUSSION

This study finds that motorists using the Nairobi Expressway prioritise operational reliability and infrastructure quality over direct monetary cost when making route choice decisions. The strong positive influence of perceived traffic flow on

route choice behaviour aligns with previous studies showing that reliability often outweighs average travel time in congested urban transport systems (Zhang et al., 2017; Wang et al., 2018). In highly congested corridors, travellers tend to value predictable movement, reduced uncertainty, and consistency in journey experience because such conditions reduce perceived travel stress and improve confidence in trip planning (Wang et al., 2018). The findings therefore suggest that motorists are more likely to select tolled facilities where reliable traffic movement is consistently experienced, even when untolled alternatives remain available.

The findings also support Random Utility Theory (RUT), which proposes that travellers select routes that maximise perceived utility derived from different travel attributes. In the context of the Nairobi Expressway, motorists appear to derive greater utility from operational reliability and infrastructure quality than from direct monetary savings associated with untolled routes. The results therefore demonstrate that perceived service quality and comfort can outweigh direct price considerations within urban toll-road decision-making.

The positive and statistically significant effect of road condition further highlights the importance of infrastructure quality, ride comfort, and maintenance standards in influencing route attractiveness. This finding is consistent with studies linking pavement quality and perceived safety to user preference for specific routes (Xu et al., 2017; Nie et al., 2018). Well-maintained road infrastructure may reinforce perceptions of reliability, safety, and professionalism, thereby strengthening public acceptance of tolled transport systems. The findings therefore support the view that toll roads operate not only as transport facilities but also as service products in which visible maintenance quality contributes directly to continued user confidence and repeat usage.

Three non-significant findings require further interpretation. First, time savings did not demonstrate a statistically significant effect after controlling for other variables. A plausible explanation is that respondents may perceive travel-time benefits as part of broader perceptions of smooth traffic flow and operational reliability,

causing traffic flow to absorb much of the explanatory influence normally associated with travel time (Wang et al., 2016; Zhang et al., 2017). This suggests that motorists may value consistency and predictability of movement more than nominal reductions in travel duration alone.

Second, toll cost did not significantly predict route choice behaviour within the multivariate model. This finding suggests that perceptions of affordability may be conditioned by the level of service delivered by the facility. Where motorists consistently experience reliable traffic movement and good infrastructure quality, sensitivity to toll charges may diminish. Similar findings have been reported within public-private partnership (PPP) transport literature, where public acceptance of toll-road projects is strongly linked to perceived service performance and value-for-money considerations (Tan & Zhao, 2019; Castelblanco et al., 2022). The results therefore imply that user willingness to pay is closely tied to confidence in the quality and reliability of the service provided.

Third, entry and exit convenience did not demonstrate a statistically significant effect on route choice behaviour. This may reflect gradual user adaptation to ramp locations following the operationalisation of the Expressway, or the possibility that access limitations affect only specific localised segments rather than corridor-wide travel decisions (Chen et al., 2018; Garg et al., 2016). Although access configuration may influence individual experiences at particular locations, its influence appears relatively limited at the broader corridor level examined in this study.

The findings further contribute important evidence from an African urban toll-road context, an area that remains underrepresented within international route-choice literature. Much of the existing empirical evidence on toll-road behaviour originates from Asian, European, and high-income transport systems characterised by different institutional, economic, and mobility conditions. The Nairobi Expressway therefore provides an important case for understanding toll-road behaviour within rapidly urbanising African cities experiencing severe congestion, infrastructure deficits, and increasing reliance on PPP-based infrastructure delivery models (KeNHA, 2024; Moja Expressway Company Limited, n.d.).

The results broadly correspond with findings from other developing-country toll-road studies where operational reliability and infrastructure quality strongly influence willingness to use tolled corridors. Similar patterns have been observed in urban toll-road systems in China, Indonesia, and parts of Latin America, where users demonstrate greater tolerance for toll charges when service quality remains dependable (Tan & Zhao, 2019; Castelblanco et al., 2022). Within African contexts, emerging PPP transport projects increasingly face pressure to demonstrate not only infrastructural efficiency but also visible improvements in user experience, reliability, and maintenance standards in order to sustain public legitimacy and acceptance.

From a transport policy perspective, the findings suggest that PPP toll-road operators should prioritise operational reliability, traffic management efficiency, and infrastructure maintenance as central components of service delivery. Investments in incident management systems, real-time traffic monitoring, lane control systems, and preventive maintenance programmes may therefore play a more significant role in sustaining Expressway usage than adjustments to toll pricing alone. The findings additionally imply that public support for future urban toll-road projects may depend substantially on the ability of operators to maintain visible service quality and predictable travel conditions over time.

Nevertheless, several limitations should be acknowledged. First, the cross-sectional design and reliance on self-reported perceptions limit causal inference and may introduce reporting bias (Story & Tait, 2019). Second, the intercept and time-location sampling strategy may under-represent certain categories of motorists or travel periods despite efforts to rotate sampling locations and time blocks (Lohr, 2021; Sudman, 1976). Third, omitted variables such as income levels, trip purpose, urgency of travel, safety perceptions, information systems, and travel habits may account for additional variation in route choice behaviour (Li et al., 2019; Wang et al., 2018). Finally, the conceptual overlap between perceptions of traffic flow and time savings may have reduced the distinct explanatory contribution of time savings within the regression model.

Despite these limitations, the study provides

important empirical insight into determinants of route choice behaviour within a contemporary African urban toll-road context. The findings reinforce the importance of operational reliability and infrastructure quality in shaping motorists' transport decisions and contribute to broader understanding of user behaviour within emerging PPP transport systems in developing urban environments.

CONCLUSION

The study concludes that route choice behaviour on the Nairobi Expressway is influenced primarily by operational reliability and infrastructure quality rather than direct monetary considerations. Perceived traffic flow and road condition emerged as the most influential determinants of motorists' preference for the Expressway, while toll cost, time savings, and entry/exit convenience demonstrated comparatively limited influence within the regression model.

These findings support Random Utility Theory by demonstrating that motorists prioritise perceived utility derived from reliable traffic movement, predictability, comfort, and infrastructure quality over direct cost savings associated with untolled alternatives. The results further suggest that urban toll roads should be understood not only as priced transport infrastructure but also as service environments in which operational consistency and visible maintenance standards play a critical role in sustaining public acceptance and continued usage (Zhang et al., 2017; Xu et al., 2017; Tan & Zhao, 2019).

The study additionally contributes empirical evidence from an African urban toll-road context, expanding understanding of motorists' behavioural responses within emerging Public-Private Partnership (PPP) transport systems operating in highly congested developing urban environments.

RECOMMENDATIONS

Based on the findings and conclusions of the study, several recommendations are proposed for policy, planning, operations, and future research. These recommendations are intended to support effective management of the Nairobi Expressway and to inform the development of future urban

toll-road projects in Kenya and other developing countries.

i. Strengthen Operations and Service Quality

Maintain operational reliability as a core Key Performance Indicator (KPI) through strengthened incident detection systems, rapid response mechanisms, lane management, and effective work-zone control in order to sustain smooth traffic flow (Wang et al., 2018).

Develop real-time user information systems including mobile traffic applications, electronic message boards, digital signage, and live traffic dashboards to improve travel predictability and user confidence during congestion, incidents, or maintenance activities (Li et al., 2019).

ii. Enhance Asset Management and Maintenance

Institutionalise continuous pavement and infrastructure condition monitoring supported by rapid-response maintenance Service Level Agreements (SLAs).

Prioritise repair of defects affecting ride comfort, pavement quality, drainage performance, and traffic safety because these factors significantly shape motorists' perceptions of infrastructure quality and service reliability (Xu et al., 2017; Nie et al., 2018).

iii. Strengthen Pricing Legitimacy and Public Confidence

Align future toll-pricing reviews with clearly communicated service-performance indicators such as travel reliability, maintenance standards, defect response time, and operational efficiency.

Improve transparency in PPP toll-road management by publicly communicating service delivery standards and operational performance indicators in order to sustain value-for-money perceptions and social legitimacy (Tan & Zhao, 2019; Castelblanco et al., 2022).

iv. Improve Access Management

Conduct periodic access and circulation audits to identify localised ramp bottlenecks, directional conflicts, and wayfinding challenges affecting specific user groups.

Prioritise low-cost operational improvements such as improved signage, lane marking adjustments,

signal coordination, and turn-lane optimisation before considering major infrastructure redesigns (Chen et al., 2018; Garg et al., 2016).

v. Improve Demand Management and User Communication

Strengthen pre-trip and real-time traveller information systems to support informed route decisions and manage user expectations during peak congestion periods or operational disruptions.

Integrate digital communication platforms, mobile notifications, and social media updates into corridor management systems to enhance public awareness and perceived reliability of the Expressway service (Li et al., 2019; Wang et al., 2018).

vi. Future Research

Future studies should utilise revealed-preference datasets such as toll transaction records, GPS trajectory data, and mobile positioning data to estimate behavioural elasticities across different user groups and to distinguish more clearly between reliability and average travel-time effects (Wang et al., 2016; Zhang et al., 2017).

Researchers should apply longitudinal and quasi-experimental research designs around operational or pricing changes in order to strengthen causal interpretation of route choice behaviour.

Additional explanatory variables including income level, trip purpose, urgency of travel, vehicle type, safety perceptions, and traveller information systems should be incorporated to improve explanatory power of future behavioural models.

Future studies should also examine segment-level access effects using spatial and geospatial modelling approaches capable of detecting localised ramp convenience impacts that corridor-wide analyses may not adequately capture (Chen et al., 2018).

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