PROCESS OF RAPID URBAN GROWTH, WAYFINDING AND INTERMODAL TRANSPORTATION SYSTEMS: A CASE STUDY OF LAGOS METROPOLIS

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DOI: https://doi.org/10.64633/wissj.v10i8.04

Keywords

Wayfinding systems; Multimodal transport terminals; User perception; Spatial legibility; Transport architecture; Lagos

Abstract

Research Problem:
Rapid urban growth, expanding passenger volumes and fragmented modal connections have increased the navigational demands placed on users of Lagos transport terminals. However, existing local studies have largely examined bus-terminal quality, ferry operations and transport infrastructure separately rather than considering wayfinding as an integrated architectural and information problem. This study addresses the need for an integrated understanding of wayfinding performance across road, rail and water transport terminals in Lagos and translates the findings into design principles for a proposed multimodal transport terminal in Marina.

Methods/Theory:
The study adopted a pragmatic sequential explanatory mixed-methods design combining questionnaire data from 320 commuters at Marina Train Terminal, Oshodi Interchange Bus Terminal and Five Cowries Ferry Terminal with ten semi-structured interviews, systematic visual observation and qualitative comparison with Daqing West Integrated Highway Passenger Station, China, and Maringá Urban Intermodal Terminal, Brazil. Data collected over six weeks between November and December 2025 were analysed using descriptive statistics, chi-square tests, Pearson correlations, multiple regression and thematic analysis. The study was guided by environmental legibility and cognitive wayfinding principles, examining the relationship between user characteristics, spatial conditions, information systems and operational management.

Results:
Overall wayfinding satisfaction varied markedly across the terminals, from 51.2% at Oshodi to 68.4% at Five Cowries and 73.8% at Marina Train Terminal. Signage inadequacy was identified by 90% of interview participants, all ten reported relying on human assistance at some point, and 70% described first-time navigation as difficult. Educational attainment was positively associated with sign comprehension (r = 0.318,

p < 0.001), age was negatively associated with digital-wayfinding satisfaction (r = -0.287, p < 0.001), terminal familiarity was associated with navigation confidence (r = 0.517, p < 0.001), and sign visibility was strongly associated with overall satisfaction (r = 0.647, p < 0.001). Multiple regression further showed that familiarity (β = 0.412), educational attainment (β = 0.283) and sign visibility (β = 0.267) jointly explained 48.3% of the variance in navigation confidence (R^2 = 0.483, F = 97.634, p < 0.001).

Conclusion:

The findings demonstrate that effective wayfinding in Lagos transport terminals depends on the interaction of user diversity, spatial legibility, information systems and operational management. Wayfinding should therefore be understood beyond signage provision and approached as an integrated navigational ecosystem that supports independent movement within complex multimodal environments.

Key Contribution to Knowledge:

The study contributes a context-sensitive wayfinding framework for high-density African transport environments by demonstrating that navigation performance is shaped not only by spatial design and information systems but also by operational conditions that sustain or weaken environmental legibility. It extends existing wayfinding perspectives by positioning terminals as navigational ecosystems rather than signage-dependent spaces.

Recommendation:

The study recommends the adoption of universal design principles, layered signage systems, improved multimodal transfer information, complementary digital wayfinding tools, trained human assistance and continuous monitoring of wayfinding performance in the planning and management of future Lagos transport terminals.

1.0 Introduction

Rapid urban growth has increased the importance and complexity of transport terminals in Lagos. Road, rail and water services now operate within a metropolitan environment characterised by high passenger volumes, congestion, time-sensitive transfers and wide differences in users' familiarity with formal transport systems. In such settings, a terminal does more than accommodate arrivals and departures: it must enable passengers to understand where they are, identify the correct destination, choose a route, complete transfers and recover from uncertainty without excessive dependence on informal assistance. The quality of this navigational experience is therefore an architectural and operational issue as much as an information-design issue.

Much of the established transport-terminal literature demonstrates that modal integration, circulation planning and information provision are important to terminal performance (Vuchic, 2005; Tadić et al., 2019; Rodrigue, 2020). Research on complex buildings further shows that floor-plan configuration, visibility, decision points, landmarks and signage affect wayfinding accuracy and confidence (Weisman, 1981; O'Neill, 1991; Dada & Wirasinghe, 1999; Fewings, 2001; Farr et al., 2012). These studies are valuable, but a substantial proportion of the empirical work has been developed in airports or comparatively standardised transport environments (Lam et al., 2003; Churchill et al., 2008; Tam, 2011). Their findings cannot simply be transferred to Lagos without considering the city's more heterogeneous user

population, variable levels of terminal familiarity, informal commercial activity and uneven operational conditions.

The limitation is even clearer in the Lagos-specific literature. Salisu et al. (2024) examined users' satisfaction with intercity bus-terminal quality and identified problems relating to information, assistance, congestion, maintenance and informal activity, but the study did not treat wayfinding as an integrated architectural and navigational problem. Ayantoyinbo and Afolayan (2024) examined the relationship between commuters' income and ferry operational costs rather than passenger navigation. Research on road infrastructure and metropolitan transformation likewise provides evidence on maintenance, performance and socio-economic effects (Oladejo et al., 2024; Odeyale & Adelaja, 2025), yet it does not explain how users negotiate spatial and informational choices within terminals. The literature therefore describes important parts of the transport experience while leaving the navigational relationship between people, space, information and terminal management under-examined.

This gap has practical consequences. Poor wayfinding can lead to wrong turns, backtracking, longer walking paths, missed transfers, and uncertainty, particularly for first-time users and people who cannot easily interpret text-heavy or digital information. International guidance recommends coordinated signs, maps, landmarks, visual access, and universal design principles (Transportation Research Board, 2011; American Public Transportation Association, 2020; Land Transport Authority, 2019), but these recommendations are largely generic and require contextual interpretation to guide design in Lagos. What is missing is evidence that links commuter characteristics, perceptible physical conditions, information systems and operational practices across different transport modes within the same metropolitan context.

Accordingly, the research problem addressed in this paper is the absence of an integrated empirical account of wayfinding across Lagos road, rail and water terminals. While existing research has examined aspects of transport operations and user satisfaction in Lagos, it has not jointly analysed spatial design, user characteristics, information systems and operational conditions as determinants of navigational performance. This study addresses that gap through a mixed-methods assessment of selected terminals and by translating the findings into a framework for the proposed Marina multimodal transport terminal. Unlike previous Lagos transport studies that examine individual modes or operational dimensions separately, this study develops an integrated wayfinding framework linking user characteristics, spatial legibility, information systems and operational management across road, rail and water terminals.

The study pursued four objectives:

i. determine the socio-economic characteristics of commuters using selected transport terminals in Lagos and examine their implications for wayfinding;

ii. assess the perceptible physical characteristics of the selected transport terminals;

iii. evaluate user perceptions of existing wayfinding systems in the selected terminals; and

iv. develop a design framework for an intuitive wayfinding system for the proposed Marina multimodal transport terminal using survey findings, case studies and international references.

2.0 Literature Review

2.1 Conceptualising Multimodal Transport Terminals

A multimodal transport terminal may be understood as a facility in which two or more transport modes are physically and operationally connected to support coordinated passenger transfers. Vuchic (2005), Rodrigue (2020) and Tadić et al. (2019) emphasise network integration, transfer efficiency and the role of terminals as critical nodes within wider transport systems. This systems perspective is essential because a terminal that merely places several modes in proximity does not necessarily achieve functional integration. Passengers must be able to recognise modal zones, understand transfer relationships and move between services with acceptable time and effort.

The limitation of a purely network or operational definition is that it can understate the micro-scale experience of the passenger. A terminal may be well connected in transport-planning terms while remaining difficult to navigate internally. Airport-planning literature has long recognised that circulation, visibility, processing sequences and information systems influence how effectively users move through complex facilities (de Neufville et al., 2013). For the present study, multimodality is therefore treated not only as the co-location of road, rail and water services but as a spatial problem of making connections understandable. This distinction is particularly important in Lagos, where modal integration must function under crowding, diverse travel experience and varying levels of familiarity with formal terminal environments.

2.2 Wayfinding in Complex Built Environments

Wayfinding is the cognitive and behavioural process through which people orient themselves, select routes and move toward destinations using spatial structure and environmental information. Arthur and Passini (1992) describe wayfinding as a sequence of decisions in which users identify their position and destination, select a route, execute movement and confirm progress. Fewings (2001) and Farr et al. (2012) similarly show that wayfinding is not reducible to reading signs; it depends on the relationship between cognition, spatial configuration and the information available at decision points.

Empirical work in airports has been particularly influential. Lam et al. (2003), Churchill et al. (2008) and Tam (2011) demonstrate that information placement, visibility and route choice can be measured and modelled in terminal settings. Dada and Wirasinghe (1999) developed an orientation index for airport terminals, further reinforcing the link between environmental configuration and navigational performance. These studies offer useful analytical tools, but their airport focus also creates a transferability problem. Airports typically operate with relatively controlled access, formalised processing sequences and standardised information systems. Lagos terminals include a broader mixture of formal and informal activities and a user base that may differ considerably in literacy, familiarity and access to digital information. The present study therefore draws on airport research without assuming that its operational context is identical to Lagos.

More recent modelling work also challenges the assumption that shortest-path calculations adequately represent real navigation. Gath-Morad et al. (2020) show that architectural configuration and three-dimensional visual information can alter wayfinding performance in ways that simplified routing models may miss. This reinforces the need to examine what users can actually perceive while moving through a terminal rather than judging the facility only by geometric distance. In practical terms, a

route that appears efficient on plan may still be difficult if decision points are visually ambiguous, destinations are hidden or information arrives too late.

2.3 Factors Influencing Wayfinding Performance

The literature identifies four closely related determinants of wayfinding performance: spatial legibility, information design, environmental cues and user characteristics. Lynch's (1960) concept of imageability proposes that people understand environments through recognisable paths, edges, districts, nodes and landmarks. Weisman (1981) and Peponis et al. (1990) extend this concern to architectural legibility, showing that the organisation and visibility of space affect the ease with which users form useful mental representations. The implication is that signage performs best when it confirms an intelligible spatial structure rather than attempting to compensate for a confusing one.

Signage and information systems remain essential, particularly at entrances, junctions, transfer interfaces and other decision points. Dada and Wirasinghe (1999), Churchill et al. (2008) and the Transportation Research Board (2011) emphasise the importance of information location, clarity and sequence. The Land Transport Authority (2019) similarly treats wayfinding as an integrated communication system rather than a collection of isolated signs. Yet sign visibility and sign usefulness are not identical. A sign can be physically conspicuous while providing insufficient destination, transfer or confirmation information. This distinction is important for evaluating terminals where users may see signs but still need to ask other people for directions.

Environmental cues add another layer. Caduff and Timpf (2008) show the orientation value of salient landmarks, while Hidayetoglu et al. (2012) demonstrate that colour and lighting influence indoor wayfinding and environmental perception. Such findings broaden the concept of information beyond written text. Changes in material, light, colour, sound, tactile surfaces and the visibility of destinations can support orientation when they are applied consistently. These cues are particularly relevant where users differ in language proficiency or literacy.

User characteristics also affect how information is interpreted. Universal-design guidance stresses that public transport environments should remain usable across differences in age, disability, literacy and technological access (American Public Transportation Association, 2020). Venter et al. (2019) situate accessibility within the wider challenge of expanding transport choices in the Global South, where mobility systems serve highly diverse populations. The central design implication is that a public terminal should not depend on one channel of communication. Text, symbols, maps, spatial visibility, tactile information, digital displays and human assistance should reinforce one another so that no single user characteristic becomes an unnecessary barrier to navigation.

2.4 Wayfinding and Transport Experience in African and Lagos Contexts

Research on transport in Nigeria and the wider Global South establishes a context in which infrastructure quality, maintenance, accessibility and informality shape user experience. Venter et al. (2019) argue for a shift from mobility provision toward meaningful access for a broad range of users. In Nigeria, Oladejo et al. (2024) show how infrastructure deterioration and traffic load affect road performance, while Odeyale and Adelaja (2025) link road-infrastructure conditions to metropolitan functioning and socio-economic outcomes. Odeyale (2025) further places transport and built-environment questions within the wider challenge of

sustainable and climate-responsive urban development in sub-Saharan Africa.

Within Lagos specifically, Salisu et al. (2024) provide evidence that terminal quality is affected by passenger information, maintenance, congestion and informal activity. Ayantoyinbo and Afolayan (2024) demonstrate that ferry operations also interact with commuter socio-economic conditions. These studies are valuable because they show that transport experience in Lagos is not determined by physical infrastructure alone. However, the literature remains segmented by mode or by performance dimension. Bus-terminal research focuses on service quality, ferry research on operational and economic issues, and road studies on infrastructure condition. None of these approaches directly explains how a passenger negotiates spatial choices when moving through and between road, rail and water services.

This fragmentation matters because the Lagos terminal environment differs from the controlled settings that dominate international wayfinding research. Informal trading can occupy circulation space, crowding can obscure visual cues, maintenance failures can reduce sign legibility, and first-time users may rely heavily on other passengers or workers. These conditions suggest that wayfinding in Lagos is partly a management problem: even a well-designed spatial system can lose legibility if routes and sightlines are not protected after construction. The literature therefore points toward a broader concept of wayfinding in which design, information and operational control are interdependent.

2.5 Research Gap and Analytical Position of the Study

International scholarship provides mature theories of spatial legibility and cognitive wayfinding, along with detailed guidance for signage and information systems (Lynch, 1960; Arthur & Passini, 1992; Transportation Research Board, 2011; Land Transport Authority, 2019). Empirical studies also demonstrate relationships between configuration, visibility and navigation in airports and complex buildings (Lam et al., 2003; Churchill et al., 2008; Farr et al., 2012). The limitation is contextual: these findings have not been sufficiently integrated with evidence from high-density African terminal environments in which user diversity and operational informality may materially change the way navigational systems perform.

The Lagos literature presents the opposite limitation. It provides locally relevant evidence on terminal quality, ferry operations, road infrastructure and urban conditions, but it does not integrate road, rail and water terminals through a common wayfinding framework. Consequently, there is no established empirical account of how commuter characteristics, perceptible physical conditions, information systems and operational practices jointly influence navigation across the principal modes. This study fills that gap by combining survey, interview, visual-observation and case-study evidence and by translating the results into design principles for the proposed Marina multimodal terminal. Its analytical position is that wayfinding should be evaluated as a socio-spatial system in which legible architecture, usable information and sustained operational order jointly support passenger decision-making.

3.0 Materials and Methods

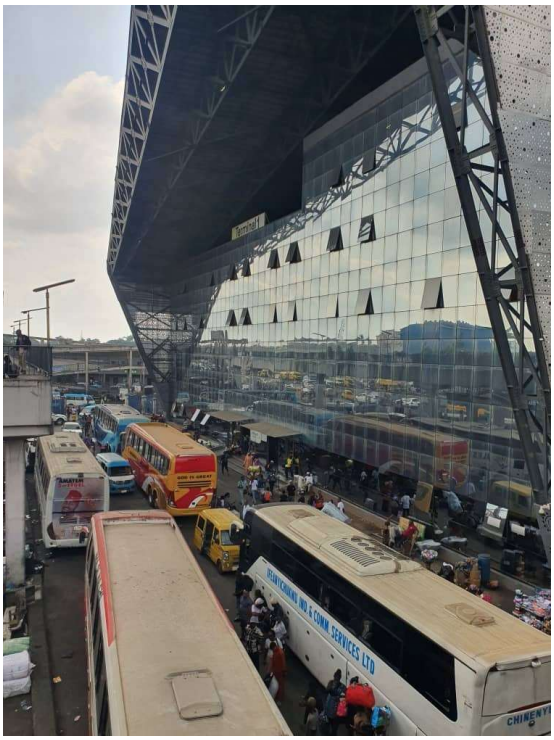
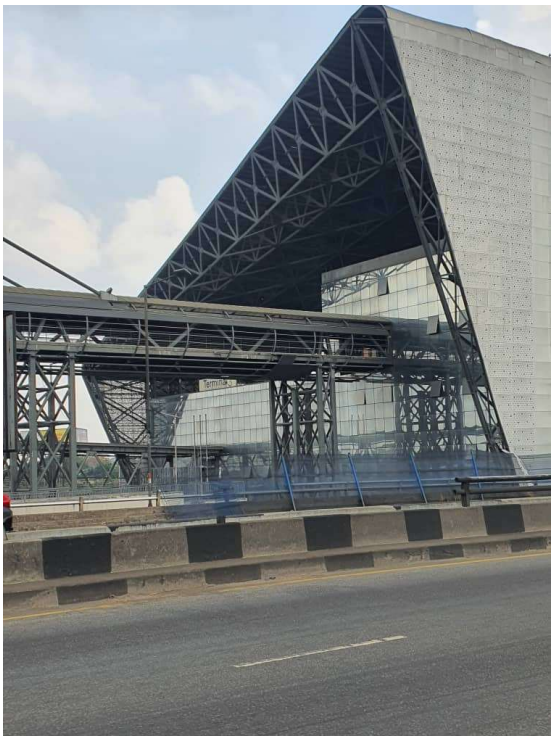
3.1 Research Design and Selection of Study Sites

The research adopted a pragmatic, sequential explanatory mixed-methods design. Quantitative survey evidence was collected first and was subsequently interpreted through semi-structured interviews and direct visual observation. A multiple-case strategy examined Marina Train Terminal, Oshodi

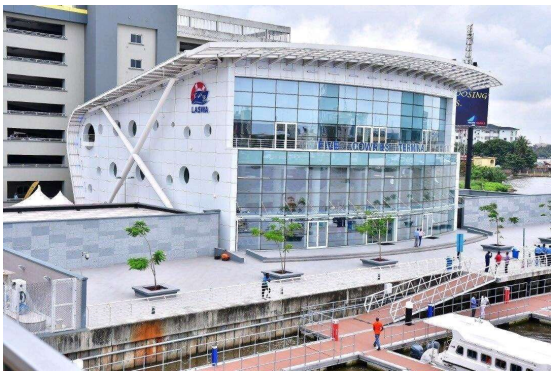
Interchange Bus Terminal and Five Cowries Ferry Terminal. The three local cases were purposively selected because they represent rail, road and water transport modes, respectively, operate within the wider Lagos/Marina mobility context, and expose passengers to different spatial and operational conditions. Their combined use therefore permitted cross-modal comparison relevant to the proposed Marina multimodal terminal, where successful navigation will depend on coordinated transfers rather than the performance of a single mode.



Figure 1: Marina Train Terminal, Lagos. Source: https://www.facebook.com/100064058467204/posts/lagos-rail-mass-transit-lrmt-blue-line-station-lagos-is-the-economic-hub-of-west/1174848314660440/

Figures 2a and 2b: Oshodi Interchange Bus Terminal, Lagos. Source: Author's Fieldwork.




Figures 3a and 3b: Five Cowries Ferry Terminal, Falomo, Ikoyi, Lagos. Source: Author's Fieldwork.

3.2 Population, Sample and Sampling

The study population comprised users of transport facilities within the Lagos terminal environment. Because the passenger population is continuously changing and could not be enumerated as a fixed list, Cochran's formula for a large population was applied, producing an initial target of 384 respondents at a 95% confidence level and 5% margin of error. Field constraints in the busy terminal environments resulted in 320 completed questionnaires, which constituted the quantitative sample analysed. Ten interview participants were purposively selected on the basis of their knowledge of the terminal environment and their ability to provide informed accounts of navigation experiences, confusion points, coping strategies and improvement needs.

3.3 Data Collection

Primary data were collected through structured questionnaires, semi-structured interviews and systematic visual surveys. The questionnaire covered socio-economic characteristics, frequency and purpose of

terminal use, perceived physical conditions, signage, information availability, digital displays, navigation confidence and overall wayfinding satisfaction. The interviews explored first-time navigation, decision-making, reliance on human assistance, confusion sources and perceived improvements, while visual observation documented circulation patterns, signage, waiting areas, environmental quality, pathway obstruction and commercial encroachment. Data collection lasted six weeks between November and December 2025. Questionnaire surveys were undertaken during Weeks 1–4 at different days and operating periods; semi-structured interviews were conducted during Weeks 4–6 so that emerging survey issues could be explored qualitatively; and visual observation continued throughout the fieldwork period.

3.4 Data Analysis, Qualitative Coding and Evidence Integration

Quantitative data were analysed using frequencies, percentages, chi-square tests, Pearson correlations and multiple regression. Descriptive statistics summarised commuter characteristics and perceptions of physical and wayfinding conditions. Chi-square tests examined terminal-specific differences, correlations assessed bivariate relationships among selected user, environmental and wayfinding variables, and multiple regression assessed the joint statistical contribution of terminal familiarity, educational attainment and sign visibility to navigation confidence. Because the design was cross-sectional, inferential results are interpreted as associations and predictive relationships rather than evidence of causation.

Interview data were analysed through a six-stage thematic procedure. The material was first reviewed repeatedly for familiarisation; meaning-based initial codes were then assigned to recurrent statements; related codes were grouped into candidate themes; candidate themes were checked against the interview material; theme boundaries and labels were refined; and the final themes were interpreted alongside survey and observational evidence. Five recurrent themes were retained: signage inadequacy; reliance on human assistance; first-time-user vulnerability; environmental degradation and spatial disorder; and demand for more explicit wayfinding support. Section 8 summarises these themes, their principal evidence and their prevalence.

Daqing West Integrated Highway Passenger Station in China and Maringá Urban Intermodal Terminal in Brazil were examined as international case-study precedents. Their function was qualitative design comparison: they were used to identify transferable principles relating to functional zoning, modal transfer, architectural legibility and information coordination. They were not treated as numerical performance benchmarks for the Lagos terminals because the reviewed guidance does not establish a universal percentage threshold for acceptable wayfinding performance. The integration of survey, interview, observational and case-study evidence provided methodological triangulation.

3.5 Ethical Considerations

The study followed ethical principles for research involving human participants. Institutional ethical approval was obtained before data collection. Participation was voluntary, the purpose of the study was explained to respondents, and informed consent, anonymity and confidentiality were maintained. Information was reported in aggregate form except for short anonymised interview statements used to illustrate recurring themes.

4.0 Theoretical Framework

4.1 Environmental Legibility at Terminal Scale

The study is anchored first in Lynch's (1960) concept of environmental legibility. Lynch proposed that people form mental representations through identifiable paths, edges, districts, nodes and landmarks. Although the framework was developed at the scale of the city, this study applies it to the smaller but cognitively intense environment of a transport terminal. At terminal scale, paths correspond to primary and secondary circulation routes; nodes include entrances, ticketing points, waiting areas, platforms and transfer interfaces; and landmarks are salient architectural or informational features that help users confirm position and direction. Weisman (1981) and Peponis et al. (1990) support this architectural interpretation by showing that legibility depends on how readily spatial configuration can be understood and navigated.

The application is deliberately more demanding than a mechanical transfer of Lynch's categories. A public terminal in Lagos must be legible not only to a familiar urban observer but also to a first-time user who may have limited literacy, limited technological access or little experience of formal multimodal systems. This study therefore treats legibility as successful perception under conditions of user diversity. A path or node is not considered functionally legible merely because it is evident on an architectural plan; it must remain perceptible in use, including when crowding, informal activity and maintenance conditions affect sightlines and movement.

4.2 Cognitive Wayfinding and Decision Support

Arthur and Passini's (1992) model complements the spatial framework by explaining navigation as a sequence of decisions. Users must recognise their current position and destination, select a route, execute that route and obtain enough confirmation to know that they remain on course. Failure can occur when decision points are ambiguous, destinations are hidden, signs are missing or contradictory, or the spatial environment imposes excessive cognitive effort. Studies of airport and building navigation reinforce the importance of decision points, visibility and information placement (Lam et al., 2003; Churchill et al., 2008; Tam, 2011).

Combining Lynch with Arthur and Passini makes it possible to distinguish two related questions: whether the terminal is spatially understandable and whether users receive sufficient information to make correct decisions within that spatial structure. This distinction is central to the present analysis. Signs, maps and digital displays are treated as decision-support tools; they should reinforce a legible environment rather than compensate for a fundamentally confusing one. The framework also explains why first-time-user performance is analytically important: repeated familiarity can mask weaknesses in spatial or informational design by allowing frequent users to rely on memory.

4.3 Contextual Extension and Contribution to Theory

The study extends the combined framework by treating operational management as a condition that sustains or erodes legibility after construction. Classical theories of legibility and wayfinding focus primarily on spatial form, cognition and information. The Lagos case indicates that these dimensions can be altered in practice by obstructed routes, commercial encroachment, damaged or obscured signs, crowding and poor environmental maintenance. The analytical framework therefore links three dimensions:

spatial legibility, information support and operational continuity.

This extension generates a testable proposition for the study: effective terminal wayfinding should reduce the extent to which users must depend on repeated familiarity or human directions to compensate for weaknesses in the environment. If navigation confidence rises mainly through repeated use, or if users routinely ask other people for directions, then the formal spatial-information system is not carrying the full navigational load. The findings are consequently used not simply to confirm Lynch (1960) or Arthur and Passini (1992), but to examine how their concepts operate in a high-density, socially diverse and operationally variable African transport context.

5.0 Socio-Economic Characteristics of Commuters and Wayfinding Implications

The commuter sample was heterogeneous. Men constituted 56.9% of respondents and women 43.1%. The largest age group was 26–34 years (31.9%), followed by 35–44 years (26.9%). Tertiary education was reported by 39.4% of respondents, secondary education by 32.5%, postgraduate education by 12.5%, primary education by 9.4%, and no formal education by 5.6%. Daily users represented 38.8% of the sample, while 11.9% used terminals rarely. Bus or coach travel was the dominant mode (51.9%), although 15.6% reported using multiple modes.

Table 1: Selected Socio-Economic and Travel Characteristics of Respondents (N = 320)

Variable	Largest/Relevant Categories	Percentage
Gender	Male / Female	56.9 / 43.1
Age	26–34 years / 35–44 years	31.9 / 26.9
Monthly income	₦101,000–₦300,000 / Below ₦100,000	36.9 / 30.0
Education	Tertiary / Secondary	39.4 / 32.5
Terminal use	Daily / Weekly	38.8 / 30.0
Primary travel purpose	Work or business	48.8
Preferred mode	Bus or coach	51.9
Multiple-mode users	Two or more modes	15.6

Source: Author's Fieldwork, 2025

The statistical results show that socio-economic characteristics were not merely descriptive background variables; they were associated with how users interacted with wayfinding information. Educational attainment correlated positively with sign comprehension ($r = 0.318$, $p < 0.001$), suggesting that text-dependent information may favour users with stronger formal literacy. Age correlated negatively with satisfaction with digital systems ($r = -0.287$, $p \leq 0.001$), while income was positively associated with overall wayfinding satisfaction ($r = 0.294$, $p \leq 0.001$).

Terminal familiarity was especially important. Frequency of use correlated strongly with navigation confidence ($r = 0.517$, $p < 0.001$). Independent navigation success was reported by 82.3% of daily users compared with 31.6% of rare users. This pattern suggests that repeated exposure may compensate for weaknesses in the environment because users appear to gain navigational competence through familiarity. The design implication is that the proposed Marina

terminal cannot be based on a single "average" commuter. It should provide perceptible and redundant information through concise text, pictograms, colour coding, maps, tactile information and strategically available staff (Arthur & Passini, 1992; American Public Transportation Association, 2020; Venter et al., 2019).

6.0 Perceptible Physical Characteristics of Selected Transport Terminals

Respondents generally recognised basic structural features in the selected terminals, but satisfaction weakened on comfort and environmental quality. Clear entry and exit points received 71.9% positive agreement, well-structured circulation routes 69.4%, adequate lighting 74.4%, sufficient seating 60.0% and ventilation or thermal comfort 54.4%.

Table 2: Positive Assessment of Selected Physical Characteristics

Physical Characteristic	Positive Agreement (SA + A)
Clear entry/exit points	71.9%
Well-structured circulation routes	69.4%
Sufficient seating/waiting areas	60.0%
Adequate lighting	74.4%
Proper ventilation/thermal comfort	54.4%

Source: Author's Fieldwork, 2025

Terminal-level comparison revealed large concurrent differences in environmental-quality perceptions and wayfinding satisfaction. Marina Train Terminal recorded 81.3% satisfaction with cleanliness compared with 38.2% at Oshodi, and the reported difference was statistically significant (χ^2 = 42.156, $p < 0.001$). Overall wayfinding satisfaction was also higher at Marina Train Terminal (73.8%) than at Oshodi (51.2%). These results show association across terminal conditions but do not, by themselves, establish that maintenance caused the difference in wayfinding satisfaction.

Commercial encroachment emerged as an important physical constraint. In the survey analysis, 31.8% of Oshodi users reported pathway obstruction compared with 8.7% at Marina. Interview participants described informal trading, crowding and environmental disorder as factors that blocked sightlines and pushed pedestrians into less safe circulation routes. These observations reinforce the argument that spatial legibility depends on the continued protection of circulation space, not merely on the original architectural plan. Routes must remain visible, decision points must not be obscured, waiting areas must be adequately sized and maintenance must preserve the environmental cues on which mental mapping depends (Dada & Wirasinghe, 1999; Fewings, 2001; Churchill et al., 2008; Hölscher et al., 2006).

7.0 User Perception of Current Wayfinding Systems

The assessment of current wayfinding systems produced moderate rather than high levels of satisfaction. Positive agreement was strongest for clarity of text and symbols (70.0%), sign visibility (69.4%), directional guidance (69.4%) and sign positioning (68.2%). Lower ratings were recorded for information-board sufficiency (59.4%), first-visit independent navigation (59.4%) and

digital displays (54.4%). Overall wayfinding satisfaction was 65.6%.

Table 3: User Assessment of Wayfinding Elements

Wayfinding Element	Positive Agreement (SA + A)
Signs are easily visible	69.4%
Text and symbols are clear	70.0%
Directional guidance is adequate	69.4%
Information boards are sufficient	59.4%
Digital displays are helpful	54.4%
Can navigate independently on first visit	59.4%
Signs are well-positioned	68.2%
Wayfinding reduces travel time	61.9%
Overall wayfinding satisfaction	65.6%

Source: Author's Fieldwork, 2025

Table 4: Terminal-Specific Wayfinding Performance

Terminal	Overall Satisfaction	Sign Visibility	Cleanliness	Navigation Confidence
Marina Train Terminal	73.8%	78.9%	81.3%	71.2%
Ferry Terminals	68.4%	71.4%	74.6%	64.8%
Oshodi Interchange	51.2%	52.3%	38.2%	47.3%

Source: Author's Fieldwork, 2025

Three recurrent deficiencies were identified when the survey and interview data were combined. The first was signage inadequacy. Ninety percent of interview participants identified missing, poorly located, insufficient or uninformative signage. Importantly, interviewees distinguished between a sign being physically visible and being useful enough to complete a journey. Improving wayfinding therefore requires both adequate sign presence and adequate information content.

The second deficiency was compensatory dependence on human assistance. All ten interviewees reported asking staff, traders, other passengers or transport workers for directions at some point. Human support is valuable, but universal reliance on it indicates that formal environmental information is not sufficiently self-explanatory. A robust system should allow most users to navigate independently while retaining trained personnel for accessibility needs, exceptional circumstances and service disruption.

The third deficiency was first-time-user vulnerability. Seventy percent of interview participants explicitly described the first visit as difficult. The quantitative association between familiarity and navigation confidence supports the finding that users acquire navigational competence through experience. For a civic transport facility, repeated exposure should not be a prerequisite for successful navigation. The first-time user should therefore be treated as a central design standard.

Sign visibility was one of the strongest correlates of overall satisfaction ($r = 0.647$, $p < 0.001$), indicating a close relationship between informational clarity and users' judgements of terminal quality. The poorer performance of Oshodi also coincided with lower cleanliness ratings and greater reported obstruction,

suggesting that signage should be considered alongside environmental order, route protection and operational conditions (Lam et al., 2003; Churchill et al., 2008; Tam, 2011).

Multiple regression provided a joint test of the factors associated with navigation confidence. Terminal familiarity was the strongest predictor ($\beta = 0.412$, $p < 0.001$), followed by educational attainment ($\beta = 0.283$, $p < 0.001$) and perceived sign visibility ($\beta = 0.267$, $p < 0.001$). Together, the three variables explained 48.3% of the variance in navigation confidence ($R^2 = 0.483$, $F = 97.634$, $p < 0.001$). The model reinforces the mixed-methods interpretation that confidence emerges from the interaction of environmental learning, information comprehension and infrastructure quality rather than from any single factor.

8.0 Qualitative Themes from Interview Data

The thematic analysis consolidated the interview evidence into five themes that converged strongly with the survey and visual observations. The themes show that navigation problems were experienced not as isolated failures of signage but as combinations of information gaps, spatial disorder, unfamiliarity and compensatory social assistance.

Table 5: Summary of Qualitative Themes and Evidence Sources

Theme	Principal Evidence	Source/Prevalence
Signage inadequacy	Missing, poorly located, insufficient or uninformative signs	9 of 10 interviewees
Reliance on human assistance	Directions sought from staff, traders, passengers or transport workers	10 of 10 interviewees
First-time-user vulnerability	Initial visits described as confusing or difficult	7 of 10 interviewees
Environmental degradation and spatial disorder	Crowding, informal trading, obstruction and maintenance problems affected sightlines and movement	Interview and visual-observation evidence; especially Oshodi
Demand for explicit wayfinding support	Requests for better signage, visible personnel, maps and route tools	9/10 signage; 8/10 personnel; 4/10 maps/route tools

Source: Authors' analysis of interview and observational data, 2025

Participants repeatedly described signage as insufficient for unfamiliar users. Statements such as "the signs are not that visible for newbies" and "I need to ask people around before I can get where I'm going" illustrate the relationship between weak formal information and compensatory social navigation. Other participants linked navigation difficulty to overcrowding, informal trading and poor environmental maintenance, particularly at Oshodi.

Participants' improvement suggestions were consistent with an integrated wayfinding approach. Nine of ten requested better signage, eight requested more visible personnel and four specifically requested maps or route tools. These should not be treated as competing solutions. The evidence instead supports a layered system in which architecture, fixed signage, maps, digital information and human assistance reinforce one another.

9.0 International Case-Study Analysis and Design Implications for Marina

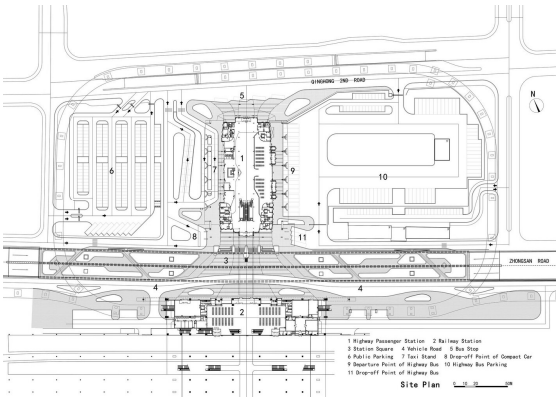
The Lagos evidence was compared qualitatively with two international cases: Daqing West Integrated Highway Passenger

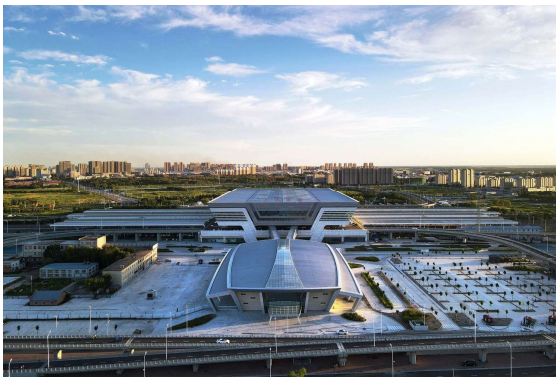
Station in China and Maringá Urban Intermodal Terminal in Brazil. The comparison focused on functional zoning, integration of commercial activity, deliberate transfer organisation and coordinated information systems. The cases were used as design precedents rather than as numerical satisfaction benchmarks because the reviewed guidance does not establish a universal percentage threshold for acceptable wayfinding performance (Transportation Research Board, 2011; American Public Transportation Association, 2020; Land Transport Authority, 2019).





Figures 4a and 4b: Maringá Urban Intermodal Terminal, Brazil. Source: ArchDaily.





Figures 5a and 5b: Daqing West Integrated Highway Passenger Station, China. Source: ArchDaily.

The international cases were not treated as templates to be copied directly. Their relevance lies in design principles that can be adapted to Lagos. The proposed Marina terminal must respond to local passenger diversity, informal commercial pressure, a tropical coastal climate and the need to integrate bus, rail and ferry services. Multimodal-planning and wayfinding guidance likewise emphasise coordinated design that responds to users, modal relationships and physical context (Tadić et al., 2019; Land Transport Authority, 2019; Rodrigue, 2020).

Five interconnected principles emerge from the comparison and the Lagos evidence. First, universal design should govern wayfinding, with information delivered through multiple perceptible channels so that differences in literacy, age, disability or technological access do not unnecessarily exclude users (Arthur & Passini, 1992; American Public Transportation Association, 2020). Second, spatial legibility should precede signage: primary and

secondary circulation routes should be differentiated, functional zones should follow a logical sequence and major nodes should be identifiable by visible destinations or landmarks (Lynch, 1960; Caduff & Timpf, 2008). Third, the terminal should meet a first-time-user standard by concentrating orientation information at entrances, transfer interfaces and decision points and by providing route confirmation after important choices (Fewings, 2001; Transportation Research Board, 2011). Fourth, multimodal transfers should be made explicit through consistent naming, symbols and spatial relationships between bus, rail and ferry zones (Vuchic, 2005; Tadić et al., 2019). Fifth, operational sustainability should be treated as part of the wayfinding system through sign-inspection schedules, route protection, cleaning, regulation of commercial activity, crowd-management procedures, staff training and routine monitoring of first-visit navigation success.

10.0 Discussion of Findings

The findings show that wayfinding in Lagos transport terminals is an integrated socio-spatial problem rather than a narrow signage problem. User characteristics affect the interpretation of information, the physical environment establishes the basic conditions for orientation, and formal information systems help users convert spatial understanding into confident movement. Operational conditions then determine whether these supports remain available in everyday use. None of the dimensions is sufficient in isolation.

The positive relationship between education and sign comprehension strengthens the argument for reducing dependence on text-heavy communication. This finding is consistent with universal-design principles that require public infrastructure to serve users with varied abilities and levels of formal literacy (American Public Transportation Association, 2020). It also gives local empirical weight to the wider accessibility concerns identified for Global South transport systems by Venter et al. (2019). The implication is not that text should be removed, but that it should be reinforced by symbols, maps, landmarks, spatial visibility and other perceptible cues.

The negative association between age and satisfaction with digital wayfinding similarly cautions against a technology-first approach. Digital displays and mobile tools can improve the speed and flexibility of information delivery, yet they should complement rather than replace fixed spatial and visual information. The lower rating for digital displays in the survey supports a layered approach in which the basic terminal remains navigable without requiring a smartphone or strong confidence with digital interfaces. This interpretation is consistent with the redundancy encouraged by universal-design and wayfinding guidance (American Public Transportation Association, 2020; Land Transport Authority, 2019).

Terminal familiarity produced one of the strongest relationships in the study. Frequency of use correlated with navigation confidence ($r = 0.517$, $p < 0.001$), and daily users reported much higher independent navigation success than rare users. The multiple-regression model reached the same conclusion after familiarity was considered alongside educational attainment and sign visibility: familiarity remained the strongest predictor of navigation confidence ($\beta = 0.412$), while the three factors jointly explained 48.3% of its variance ($R^2 = 0.483$, $F = 97.634$, $p < 0.001$). A terminal that becomes easy only after repeated exposure shifts part of the navigational burden from the environment to the passenger. This finding operationalises Arthur and Passini's (1992) decision-support model and strengthens the

case for using first-time-user performance as a design criterion.

The strong association between sign visibility and overall satisfaction ($r = 0.647$, $p < 0.001$) confirms that information clarity matters, but the terminal comparisons show why signage cannot be evaluated separately from physical order. Marina Train Terminal achieved higher ratings than Oshodi for cleanliness, sign visibility, navigation confidence and overall satisfaction, while Oshodi recorded substantially more reported pathway obstruction. These concurrent differences do not establish a causal effect of maintenance on satisfaction, but they are consistent with the proposition that legibility is vulnerable to operational deterioration. Signage becomes less useful when it is obscured, routes become less understandable when commercial activities occupy circulation space, and environmental disorder can weaken landmarks and visual continuity.

The qualitative evidence deepens this interpretation. Universal reliance on human assistance shows that commuters have developed adaptive social strategies to compensate for formal information gaps. Human interaction is valuable for special needs, reassurance and service disruption, and the study does not suggest removing it. However, staff, traders and other passengers should not function as the primary information infrastructure for routine journeys. Formal wayfinding should carry the normal navigational load, with human assistance providing an additional layer of support.

The international case-study comparison reinforces the same conclusion. The main lesson from Daqing West and Maringá is not simply the presence of more signs; it is the coordination of zoning, circulation, architectural expression and information systems. This supports Lynch's (1960) argument that users require a coherent environmental image and Arthur and Passini's (1992) emphasis on information at decision points. The Lagos findings extend these perspectives by showing that, in a high-density and operationally variable terminal environment, legibility must also be protected through management. Spatial order is therefore not a one-time design achievement but a condition that has to be maintained.

The study's principal contribution to literature is this integrated account. Existing Lagos studies have examined terminal satisfaction, ferry operations and infrastructure performance separately, while much international wayfinding research concentrates on airports or standardised building environments. By analysing road, rail and water terminals through a common framework, the present study shows how commuter diversity, spatial conditions, information systems and operational practices jointly shape navigation. The resulting concept of the terminal as a "navigational ecosystem" provides a context-sensitive basis for the proposed Marina terminal and a transferable analytical proposition for other dense African transport environments.

11.0 Conclusion

This study assessed wayfinding in selected Lagos road, rail and water terminals and translated the evidence into design principles for the proposed multimodal transport terminal in Marina. The findings show that terminal wayfinding is produced by the interaction of user diversity, spatial legibility, information quality and operational management. Signage is important, but it cannot compensate fully for ambiguous spatial organisation, obstructed circulation or weak maintenance.

The evidence also shows that unfamiliar users carry a disproportionate navigational burden. Education was associated with sign comprehension, age with satisfaction with digital systems, familiarity with navigation confidence and sign visibility with overall

satisfaction. The repeated need for human directions and the difficulty reported by first-time users demonstrate that formal wayfinding systems do not yet support independent navigation consistently. Effective multimodal wayfinding in Lagos therefore requires a shift from post-construction signage solutions toward integrated environmental design in which spatial hierarchy, redundant information, explicit transfer routes and operational continuity are planned together.

The study contributes to wayfinding scholarship by demonstrating that legibility in a high-density African transport context is not only spatial and informational but also operational. A terminal remains legible only when the routes, visual cues and information systems on which users depend are protected and maintained over time.

12.0 Recommendations

1. Adopt universal design as the governing wayfinding framework. Information should not depend on literacy, smartphone ownership or a single sensory channel. Concise text should be reinforced by standardised pictograms, consistent colour logic, maps and, where appropriate, tactile and auditory information.
2. Prioritise legibility by design. Primary and secondary circulation routes, entrances, ticketing, waiting, boarding and transfer zones should form an intelligible spatial hierarchy before detailed signage is introduced. Destinations should be visually connected where possible, and memorable architectural landmarks should identify major nodes.
3. Implement a layered signage and information strategy. Orientation information should begin at terminal approaches and entrances, become more specific at decision points and transfer interfaces, and provide confirmation near destinations. Sign location, contrast, illumination, terminology and maintenance should be consistent across the facility.
4. Use digital wayfinding as a supplement rather than a substitute for environmental legibility. Real-time displays, kiosks and mobile information can improve service communication, but the terminal should remain independently navigable for users who have limited technological access or lower confidence with digital systems.
5. Formalise human assistance as a secondary support layer. Trained and clearly identifiable personnel should be available at entrances, major decision points and modal interfaces for accessibility needs, unusual disruptions and first-time-user support. Assistance requests should also be recorded as feedback that can reveal recurring information gaps.
6. Design multimodal transfers explicitly. Bus, rail and ferry zones should use consistent names, symbols and route logic, with transfer information stating both direction and destination. Walking relationships between modes should be direct, weather-protected where practicable and free from unnecessary reversals.
7. Integrate commercial activity without sacrificing circulation. Retail and informal economic activity should be accommodated in designated areas that do not obstruct primary paths, decision points or sightlines. Peak-period crowd management should preserve the visibility of signs, entrances, exits and transfer connections.
8. Improve climate responsiveness and environmental comfort while preserving visual connectivity. Adequate lighting,

ventilation, shaded or protected movement routes, sufficient waiting capacity and clear sightlines should be treated as part of the wayfinding environment because crowding and environmental discomfort can weaken orientation and information perception.

9. Institutionalise maintenance and wayfinding performance monitoring. The operator should establish scheduled inspection and replacement of signs, cleaning standards, protection of circulation routes, staff training and periodic checks of first-visit navigation success, direction-asking frequency and recurring confusion points.

10. Use participatory testing and post-occupancy evaluation. Proposed routes, signs, maps and modal-transfer information should be tested with first-time users and participants with different ages, literacy levels and mobility needs before full implementation. After opening, user surveys, interviews and behavioural observations should be repeated so that the system can be corrected as operating conditions change. The resulting evidence can also support more consistent Lagos-wide wayfinding standards.

13.0 Limitations and Future Research Directions

Several limitations define the boundaries of the findings. The analysed survey sample comprised 320 completed questionnaires rather than the initial Cochran target of 384, and the empirical fieldwork was restricted to three selected Lagos terminals representing road, rail and water modes. The results therefore provide strong context-specific evidence but should not be interpreted as statistically representative of every transport terminal in Lagos or Nigeria.

The study was cross-sectional and relied substantially on self-reported perceptions, although interviews and direct visual observations were used to provide complementary evidence. Consequently, the observed relationships among maintenance conditions, signage, familiarity and satisfaction cannot establish causal effects of specific design interventions. Older users, people with disabilities and international visitors were also represented in relatively small numbers, limiting detailed conclusions about specialised accessibility needs.

The international cases were used as qualitative design precedents rather than direct performance benchmarks because differences in culture, governance, climate, operational systems and passenger profiles prevent simple one-to-one comparison. Future research should therefore incorporate systematic behavioural mapping of actual navigation paths and errors, controlled pre- and post-intervention studies, larger samples of vulnerable user groups, comparison across a wider range of Lagos terminal types, post-occupancy evaluation of the proposed Marina terminal, and cross-city studies that test whether the framework transfers to other dense African urban contexts.

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