

THE ONITSHA TRADE GATEWAY: A SUSTAINABLE TRAIN STATION FRAMEWORK FOR ANAMBRA STATE [LESSONS FROM NIGERIA AND THE NETHERLANDS]

Oluebube P. Okafor¹, Chijioke C. Onwuzuligbo²

^{1,2}Department of Architecture, Chukwuemeka Odumegwu Ojukwu University, Uli Campus, Nigeria

Email: ¹ebupamela@gmail.com; ²cc.onwuzuligbo@coou.edu.ng

Abstract

Train stations in Nigeria's commercial hubs face a persistent sustainability gap. Train station design quality plays a critical role in shaping trade efficiency, mobility outcomes, and regional environmental sustainability. In Nigeria, train stations often face design limitations that restrict their effectiveness in supporting cleaner transport and intercity trade. This study explores the current design condition of selected train stations, with a particular focus on identifying opportunities for improvement through the integration of sustainable design elements, and proposes a conceptual framework, "the Onitsha trade gateway," for a sustainable train station intended to link the commercial city of Onitsha to Aba. Using a case study approach, the study drew on existing peer-reviewed literature, sustainability assessments, and institutional documentation on three stations: Mobolaji Johnson Station, Obafemi Awolowo Station in Nigeria, and Utrecht Central Station in the Netherlands. The study emphasises the need to reevaluate train station design in Nigeria and proposes adopting sustainable design principles, informed by local precedent and international practice, as a practical way to close this gap. The paper offers context-specific design principles intended to inform future sustainable rail infrastructure planning and policy in Nigeria.

Keywords: Cleaner Transport, Onitsha Trade Gateway, Sustainable Rail Infrastructure, Trade Facilitation, Transit-Oriented Design

INTRODUCTION

Nigeria's transportation sector remains dominated by road transport, which is overused and poorly integrated with rail and waterway systems, resulting in environmental strains and constrained economic contribution from the sector as a whole (Onokala et al. 2020). These infrastructural deficits are particularly consequential for trade, since a functional multimodal transport network is necessary to move goods and people efficiently across the country (Onokala et al. 2020). Anambra State, home to major commercial hubs such as Onitsha, exemplifies this tension between high trade volume and inadequate mobility infrastructure.

Three compounding challenges define transport conditions along the Onitsha–Aba corridor. First is market inefficiency: traders transporting perishable goods face prolonged travel time, the lack of adequate freight infrastructure and the absence of cold chain facilities, resulting in post-harvest losses and depressed market returns. Secondly, mobility deprivation causes commuters to endure congested and unreliable road journeys with no viable alternatives. And thirdly, vehicle-generated air pollution, caused by the high density of vehicles, tricycles, which are locally known as (kekenapep) and minibuses, which produce significant amounts of exhaust emissions, contributes to poor air quality and public health consequences for roadside communities.

Globally, the emergence of train stations as a multifunctional hub, integrating transit, commerce and sustainability, has gained traction under transit-oriented development. In the African context, light rail systems in Lagos and Abuja have proved that rail infrastructure, when contextually adapted, can generate measurable environmental and economic benefits, including reductions in carbon emissions and increased commercial activities (Alade et al., 2019).

This paper presents “the Onitsha trade gateway”, the conceptual framework developed from theoretical foundations and the comparative case study findings discussed in the paper. The framework is presented as a guiding principle and a structural model showing how a sustainable train station in Onitsha, Anambra State, can achieve trade facilitation, mobility and cleaner transport.

The aim of this paper is to examine the current trade and mobility infrastructural challenges in Onitsha, Anambra State, review sustainable train station and transit-oriented development practices from the case studies and also identify transferable sustainability strategies applicable to Anambra State. This study is guided by the following research questions:

- i. What sustainable design strategies are evident in the selected Nigerian and international case studies, and to what extent are they present or absent?
- ii. What trade and mobility infrastructure challenges currently affect the Onitsha trade corridor?

LITERATURE REVIEW

Theoretical framework

This study is grounded in the Triple Bottom Line (TBL) framework (Elkington, 1997), which evaluates sustainability along three interdependent dimensions: economic, social and environmental. The proposed station is expected to simultaneously generate and facilitate trade value, improve mobility access for the population and also reduce the environmental footprint of transport.

Concept of sustainable design.

Sustainable design is a concept derived from the idea of sustainable development; it refers to an approach to planning and construction that aims to meet needs without causing long-term harm to the environment, economy or society. Sustainable design takes into consideration the full life-cycle of a project, from planning and construction to daily use, with the sole aim of reducing negative environmental impact while improving the well-being of the people who use it (Syam et al., 2023). In architectural and infrastructural development, sustainable design involves certain principles which include energy-efficient construction, passive design strategies such as natural lighting, ventilation, waste reduction and use of materials, and systems that minimise a facility's long-term environmental footprint (Esau, Daminabo, & Owzor, 2023). It goes beyond adding solar panels or planting trees around a facility. It involves the strategic use of building orientation, materials, and spatial layout, together with energy systems that work together to reduce a building's energy consumption, while improving how it effectively serves its users.

Introducing sustainable design in train stations has a lot of significant functional benefits. Rail systems assessed using sustainability-based performance measures have shown that energy-efficient operations and energy-conscious design improve transport performance (Gandhi, Kant, & Thakkar, 2022). For the users, sustainable design principles provide improved comfort and reduced waiting time, making the station usable for daily commuters. Despite these benefits, many train stations in Nigeria lack sustainable design features. This gap is often a result of budget constraints, limited technical capacity and low awareness of sustainable design benefits (Onokala et al., 2020). This is precisely the gap the "Onitsha trade gateway" framework seeks to address for Onitsha's train station.

History and Theory Behind Sustainable Architecture.

Designing structures in harmony with the environment is not new. Early civilisations constructed with local materials, natural ventilation and climate-responsive layout simply because that was the only means available to build durable and comfortable structures without technology.

Sustainability as a formal concept, however, only gained academic attention in the 20th century. The idea can be traced to 1969, when the International Union for Conservation of Nature adopted a new conservation-focused direction, followed shortly after by the Club of Rome's 1972 publication "The Limits to Growth," which warned about unchecked industrial growth and its implications for the planet's resource capacity (Eyüboğlu & Faiz Büyükcım, 2024).

In recent decades, the theory of sustainability has moved beyond building design alone. It is now actively applied to transport infrastructure, including rail systems, where its performance is assessed and evaluated to determine whether the train station facility is environmentally responsible, economically viable and socially beneficial.

Benefits of sustainability in rail transportation system

Numerous studies have linked sustainable design interventions in railway stations to measurable improvements in energy performance, cost efficiency, and user experience.

In a high-traffic commercial context such as Onitsha, where a train station would be expected to handle heavy daily footfall from traders and commuters alike, these benefits are enormous. A congested, poorly ventilated, or energy-inefficient station not only harms the environment; it directly undermines the commuter experience and the trade efficiency the station is meant to support. Incorporating elements such as energy-efficient lighting, natural ventilation, water and waste management systems and, where feasible, solar power generation can create a station that is not only more environmentally responsible but also more functional, comfortable, and cost-effective to manage Benoliel, Ferreira, & Matos Silva, 2023; Matos Silva et al., 2019).

Train station facility design standards

Train stations require specific architectural considerations, including layouts that support safe passenger circulation, accessibility, and efficient integration with surrounding transport and trade activity. According to Network Rail's station design principles, stations must be designed with inclusiveness at the centre of the process, accommodating people of varying mobility levels, reducing barriers to access, and ensuring the whole-life sustainability of the building facility across its economic, environmental, and social dimensions (Network Rail, 2019).

International sustainability-based station assessments demonstrate that energy, water, air quality, and comfort performance must be evaluated together as core design standards (Benoliel, Ferreira & Matos Silva, 2023).

However, many Nigerian train stations have historically been designed without these standards fully in mind, resulting in outdated layouts, poor climate responsiveness, and limited attention to passenger comfort. Incorporating sustainable design elements can improve user experience without compromising a station's core transport function. For instance, large windows for daylighting, natural materials in interior finishing, and the integration of green spaces around waiting and circulation areas have been directly linked to passenger preference and comfort. A study of railway station waiting areas found that the presence of greenery and large windows were the most strongly preferred design features among commuters, ahead of lighting colour and seating arrangement (Building Research & Information, 2025). While research increasingly supports the benefits of sustainable and nature-responsive design in train stations, there is insufficient research focusing specifically on its application to Nigerian train stations. Most Nigerian research on sustainable architecture centres on general building typologies (residential, commercial, institutional), with limited attention paid to transport infrastructures (Mba et al., 2024). This gap proves the need for context-specific research, which explores how sustainable design standards, if effectively implemented in the Onitsha train station, would enhance both commuters' experience and support the trade function in the state.

RESEARCH METHODOLOGY

Research Design

This study employs a case study research design, focusing on documentary and comparative engagement with the spatial, functional, and sustainability realities of selected train stations. This approach allows for a rich, context-specific exploration of how architectural features, particularly sustainability elements, impact users' and staff perception. It prioritises narrative, observational, and experiential data.

Study Area

The study centres around three train stations: the Mobolaji Johnson Station at Ebute Metta (Lagos), the Obafemi Awolowo Station at Moniya (Ibadan), and Utrecht Centraal Station (Netherlands), for their importance and documented relevance to sustainable railway design. Data were obtained through secondary sources including published literature and maps.

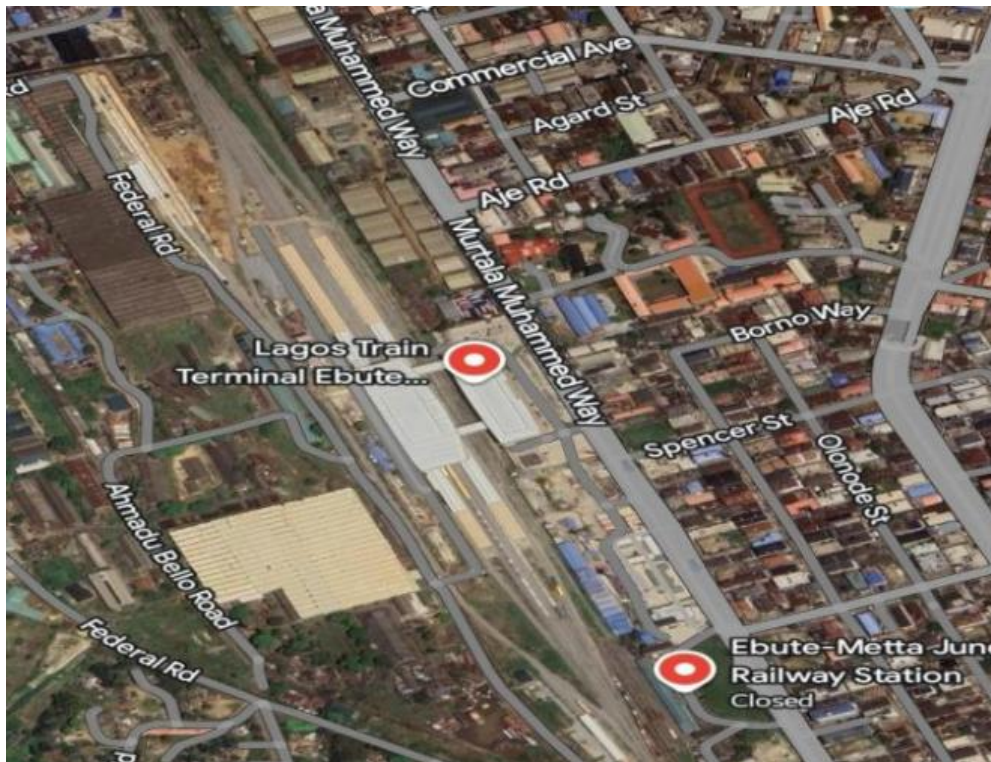


Figure 1: Mobolaji Johnson Train Station, Lagos

Source: Google Maps (2016)

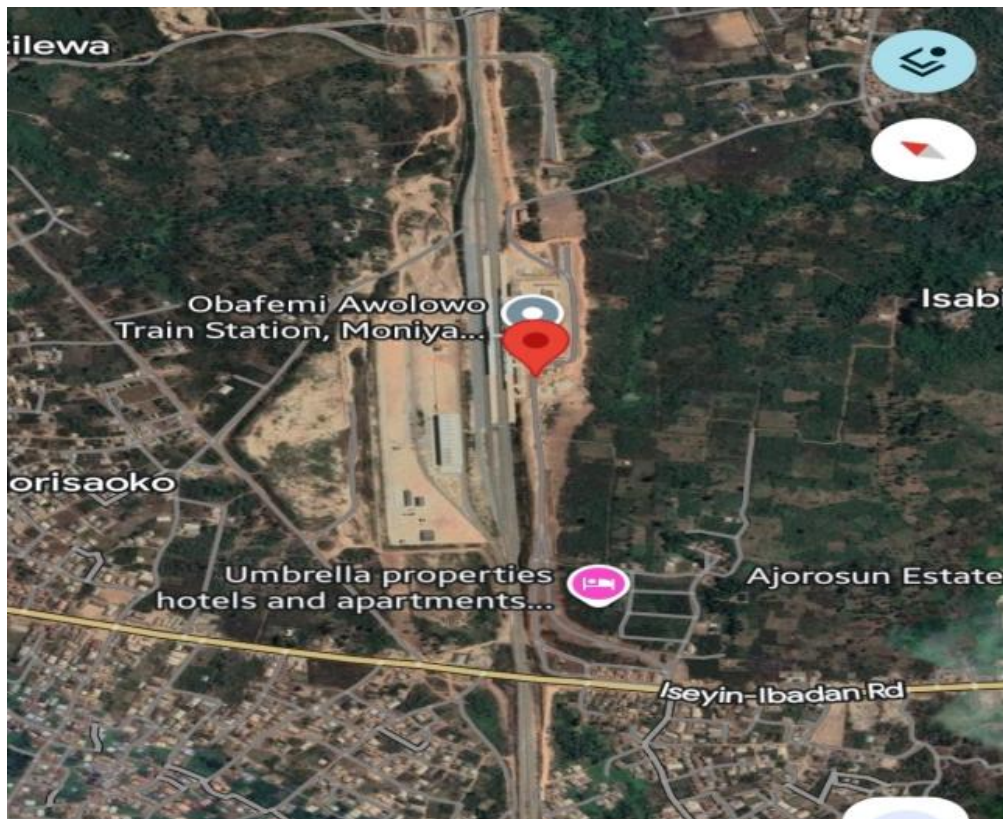


Figure 2: Obafemi Awolowo Train Station Map
Source: Google Maps (2016)

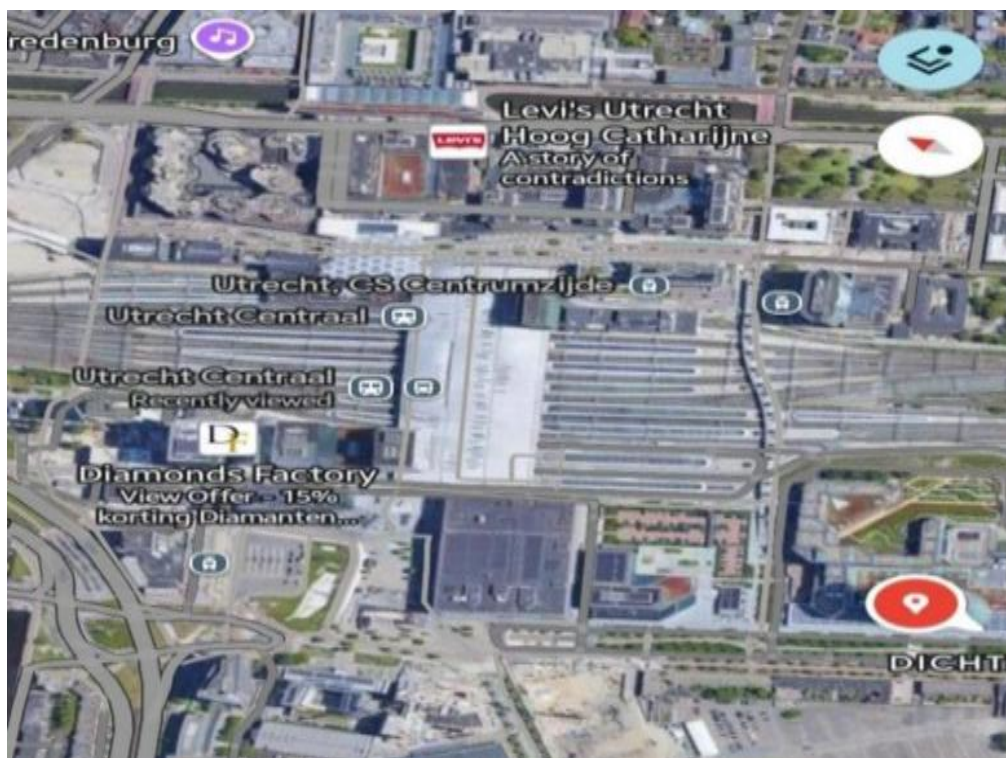


Figure 3: Utrecht Centraal Station, Netherlands
Source: Google Maps (2016)

Methods of Data Collection

Data for this study were gathered through a case study approach; secondary data were sourced from existing academic literature, published transport authority reports, and case study documentation. This process involved a close systematic review of how each station has approached sustainable design: what strategies were adopted, and the challenges and limitations that emerged in the implementation of the various sustainability strategies.

Case Studies

Each station was studied carefully. Observations and interviews were conducted with facility personnel. The case study method helped situate each train station within its broader architectural and transportation context.

Data Analysis Method

Documented case study materials, sustainability assessments, and performance reports relating to the selected stations were carefully reviewed and thematically coded to identify recurring patterns, design strategies and notable environmental features.

DATA PRESENTATION AND ANALYSIS

Introduction

Data were collected and analysed from documented case studies of selected train stations in Nigeria and the Netherlands. Data for each case study were gathered through existing published literature, sustainability performance assessments, field observation and oral interviews. The aim of this analysis is to understand how each station has approached or failed to approach sustainable design across the three core dimensions of this study (trade facilitation, mobility, and cleaner transport). Thematic analysis was used to code and categorise the information obtained from these documented sources, while cross-case comparison helped to contextualise patterns across the Nigerian and international case study examples.

Case Study Overview

Each train station was examined as an individual case with regard to architectural layout, sustainable features, and users' comfort.

Nigerian Case Studies:

i. Case Study One:

Name: Mobolaji Johnson Station, Ebute Metta, Lagos.

Location: Mobolaji Johnson Station is located along Murtala Muhammed Way in the Ebute Metta/Algomeji area of Lagos, Lagos State, Nigeria.

Train Station Overview: Commissioned in 2021, Mobolaji Johnson Station is the flagship terminal of the Lagos-Ibadan standard gauge railway. It is currently the largest railway station in West Africa, with a holding capacity of approximately 6,000 passengers. Built by China Civil Engineering Construction Corporation (CCECC).

Service and Facilities:

The Mobolaji Johnson Train Station offers the following services:

1. Air-conditioned waiting area.
2. Accessible pathway for passengers with disabilities.
3. Digital departure display similar to those found in airports.
4. Extensive parking space.



Figure 4: Mobolaji Johnson Train Station, Lagos
Source: Google Maps (2016)



Figure 5: Platform and track area
Source: Google Maps (2016)



Figure 6: Mobolaji Johnson Train Station, Lagos
Source: Google Maps (2016)



Figure 8: Mobolaji Johnson Train Station, Lagos
Source: Google Maps (2016)

Merits:

1. The inclusion of disability access for easy accessibility
2. As a high-capacity rail alternative to road travel between two major economic cities, the line contributes to reducing road congestion associated with bus-based intercity travel.

Demerits:

1. The station was designed around private vehicle access, with poor integration with surrounding transport modes (buses, taxis, and non-motorised transport).
2. Sustainability features were not fully implemented in the train station building design.

Deductions

1. Integration of renewable energy systems
2. Adopting passive design strategies by introducing improved natural lighting and ventilation systems
3. Establish a sustainability performance monitoring system, which would help track and improve the station's environmental performance over time.

ii. Case Study Two:

Name: Obafemi Awolowo Station, Moniya, Ibadan

Location: Moniya, Oyo State, Nigeria.

Train Station Overview: Commissioned in June 2021, the Obafemi Awolowo Station serves as the Ibadan terminus of the Lagos-Ibadan standard gauge railway. Built by China Civil Engineering Construction Corporation (CCECC).Its design considered intermodal connectivity, internal circulation efficiency, and the accommodation of both intercity passengers and freight.

Service and Facilities:

1. Air-conditioned waiting area.
2. Ticketing counter
3. Accessible pathway for passengers with disabilities.
4. Digital departure display similar to those found in airports.
5. Extensive parking space.

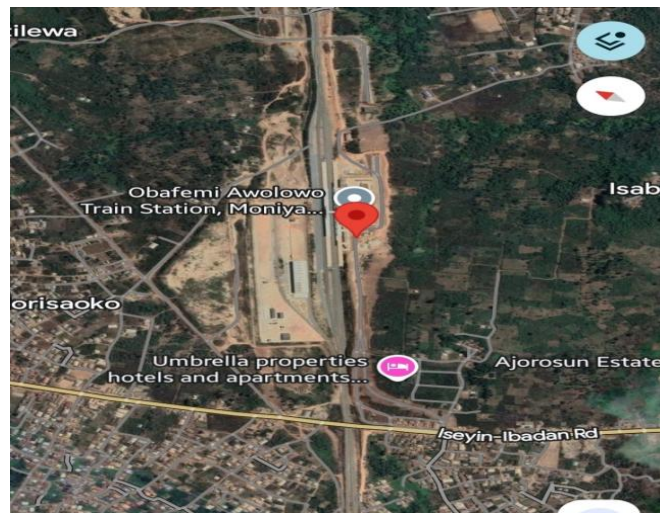


Figure 8: Obafemi Awolowo Train Station Map
Source: Google Maps (2016)



Figure 9: Platform Area
Source: Google Maps (2016)

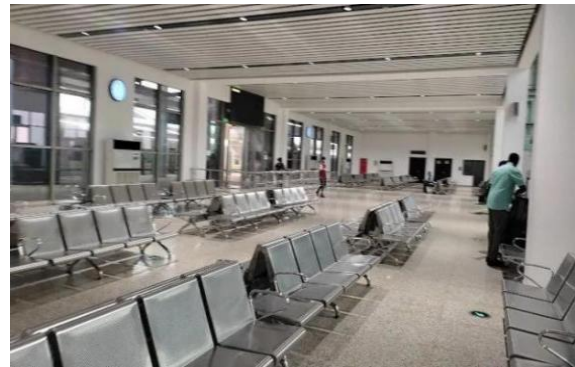


Figure 10: Waiting Area
Source: Google Maps (2016)

Merits :

1. The train station prioritises passengers' comfort and user experience.

Demerits:

1. Sustainability features were not fully implemented in the train station building design.
2. No on-site renewable energy generation; total grid dependency led to disconnection by IBEDC in 2025 for non-payment, collapsing all electrical operations.
3. Station is spatially isolated from the urban fabric, creating safety risks,

Deductions

1. Diversify energy resources by incorporating on-site renewable energy.
2. Prioritise passenger comfort by introducing sustainability features that allow for passive ventilation and lighting.
3. Introduce systems that allow for smooth passenger flow in the train station.

International Case Study:

iii. Case Study Three:

Name: Utrecht Centraal Station, Utrecht, Netherlands

Location: Utrecht, Netherlands

Train Station Overview: Utrecht Centraal Station is the busiest railway and bus station in the Netherlands, handling over 207,00 boarding and alighting passengers daily(excluding transfers) across sixteen platform tracks, with more than 1,000 train departures per day. The station was originally opened in 1843; the station underwent major redevelopment in the 1960s- 70s that had poorly connected the station to the city, replacing it with a pedestrian-oriented public square, restored historic canals, and a mixed-use green boulevard linking the station directly to the city centre.



Figure 11: Utrecht Centraal Station, Netherlands

Source: Google Maps (2016)



Figure 12: Showing Platform and Track Area

Source: Google Maps (2016)



Figure 13: Showing concourse Area

Source: Google Maps (2016)



Figure 12: Showing Waiting Area

Source: Google Maps (2016)

Merits:

1. Integration of a low-carbon-emission, multi-modal strategy.
2. The station is human-centred as it promotes the well-being of users and is environmentally friendly.
3. The station building was designed with skylights and glass roofing to maintain a sense of openness and comfort.

Deduction:

1. Train stations should be designed as an urban redevelopment opportunity, as it's relevant to trad-zone integration.
2. Adopting passive design strategies by introducing improved natural lighting and ventilation systems

Case Study Data Summary

A structured checklist documented sustainable design elements across all three sites. Key comparative findings include:

Table 1: Structured Checklist

SN	Sustainability element	Observations
1	Environmental Design	Mobolaji Johson Station and Obafemi Awolowo Station didn't implement environmental design features .this stations have no documented use of renewable energy, passive cooling and ventilation. The Utrecht Centraal Station on the other hand, is a contrast of the Nigerian train stations.The station was designed with skylight to bring in natural light, reflecting environmental design philosophy
2	Social sustainability and accessibility	This element was moderately implemented in Nigerian station (Mobolaji Johnson and Obafemi Awolowo Train Station and strongly in the Utrecht Central Station. Mobolaji Johnson Station featured disability access, medical support facilities etc. The Utrecht Centraal Station featured pedestrian first, safety-conscious design that prioritizes ease of movement for cyclist and pedestrians alike.
3	Mobility integration	No organized drop-off or taxi zones, no dedicated freight access, no cycle storage, no real-time information system was featured in the Nigerian train stations. Both the Mobolaji Johnson and Obafemi Awolowo Train Station was designed primarily for private car access with little pedestrian infrastructure. Mobility was keenly considered in the Utrecht Centraal Station, by providing bicycle parking and other pedestrian access infrastructure.
4	Mobility and Economic Integration	None of the stations were designed with the objective of trade facilitation, except the Utrecht Centraal which supports a dense mixed-used commercial district around the station.

Source: Synthesis from case study analysis (2016)

Comparative Summary Table

A comparative design analysis and performance evaluation of all three case studies across eight (8) criteria was done, enabling cross-case identification of performance gradients. To ensure transparency, each sustainability element was rated using a four-point ordinal scale based on the presence of documented features. (absent, minimal, moderate and comprehensive).

Table 2: Comparative Design Analysis of all Three Case Study Stations

Sustainability element	Mobolaji Johnson Station	Obafemi Awolowo Station	Utrecht Centraal Station	Proposed Onitsha Station
Spatial Layout	Absent	Moderate	Comprehensive	Will be optimized
Traffic Flow Management	Absent	Moderate	Comprehensive	Will be Optimized
Sustainability	Minimal	Absent	Comprehensive	Will be Optimized
Multimodal Connectivity	Absent	Minimal	Comprehensive	Will be Optimized
Commercial Integration	Minimal	Absent	Minimal	Will be Optimized
Biophilic / Green	Absent	Minimal	Comprehensive	Will be Optimized
Accessibility	Minimal	Minimal	Comprehensive	Will be Optimized
Energy Strategy	Absent	Absent	Comprehensive	Will be Optimized

Source: Synthesis from case study analysis (2016)

Interpretation of Findings

From the comparative examination, the study confirms that environmental sustainability is severely lacking across both Nigerian case studies, while it is relatively present at the Utrecht Centraal Station. This study shows that its absence is a matter of design priority, not technical impossibility.

Operational vulnerabilities and mobility inefficiencies were observed at Mobolaji Johnson Station and Obafemi Awolowo Station, where environmental sustainability design features such as renewable energy integration, passive cooling, and multi-modal connectivity were lacking in the train station design. These features could improve the station's energy resilience, commuters' comfort and long-term operational cost-effectiveness. This observational analysis shows that the Nigerian case studies did not optimise trade efficiency and the mobility function of their stations.

Sustainable design is not yet treated as a core requirement in Nigerian train station development. This gap forms the basis for the study, establishing that a sustainable train station for Onitsha must integrate environmental design and trade-corridor function from the outset, rather than replicate the comfort-focused, environmentally weak model observed in existing Nigerian rail infrastructure.

The Onitsha Trade Gateway, a conceptual framework

A conceptual framework was developed from the study's theoretical findings through the comparative case studies; the framework is guided by the Triple Bottom Line(TBL) and transit-oriented development principle and is intended to guide the future design of a sustainable train station in Onitsha. It establishes key principles that can inform future architectural and engineering design development. The framework responds to weaknesses identified in the Nigerian case studies while retaining useful features such as passenger comfort and accessibility. The evidence from Utrecht Centraal Station will also be incorporated, particularly its approach to environmental design, multi-modal transportation, pedestrian movement and long-term capacity planning. The framework therefore proposes that the Onitsha station should function not only as a transportation facility but also as an important connection between trade, mobility and sustainable development.

The Three Pillars of the Framework

The framework is organised around three interconnected pillars: trade facilitation, mobility integration, and cleaner transport. Trade facilitation involves providing dedicated cargo-handling areas, coordinating rail services with major trading periods, and involving local trade stakeholders to support the movement of goods between Onitsha and Aba. Mobility integration focuses on accommodating local transportation modes such as keke napep, minibuses, and pedestrians, while also providing accessibility facilities. Clean transport involves the use of renewable energy, particularly solar power, together with passive design strategies such as natural lighting and natural ventilation, as well as effective water and waste management. The framework also introduces scalability as a cross-cutting principle, which ensures that the future increase in passenger numbers and trade activities is considered from the beginning of the design process.

In summary, the Onitsha trade gateway provides a context-specific approach for developing a train station that can support economic activities, improve mobility, reduce environmental impacts, and respond effectively to the future growth of the Onitsha-Aba trade corridor.

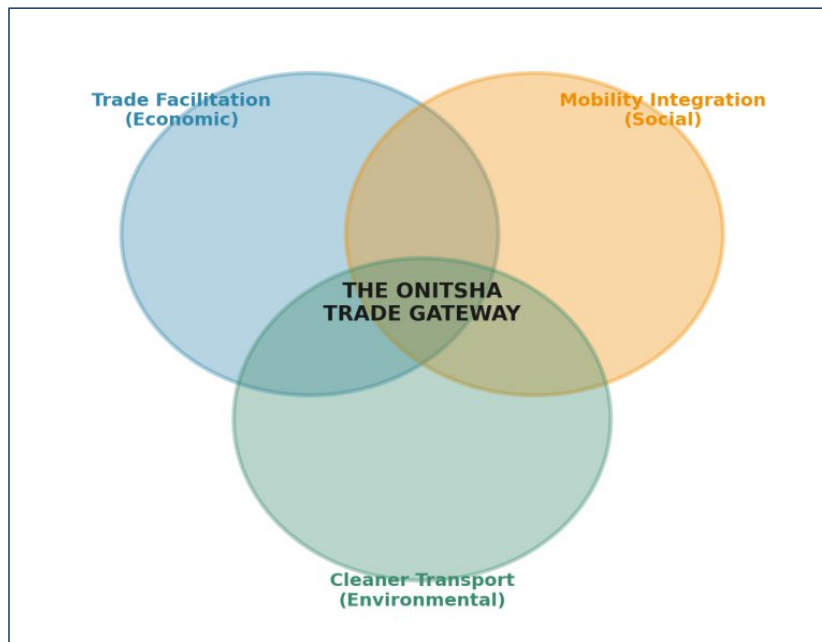


Figure 15: Conceptual Model of The Onitsha Trade Gateway Framework

Source: Author's construct, 2026

Justification of the Framework

This table links each proposed framework element to specific findings from the case studies, showing that the framework is grounded in evidence rather than based on general sustainability principles.

Table 3: Justification Of Framework Elements Against Case Study Findings

Framework Element	Case Study Finding It Responds To	Relevance to Onitsha
On-site solar energy generation	Both Nigerian stations shows an absent rating for energy strategy, with Obafemi Awolowo Station having experienced an actual grid related service disruption	Providing solar energy would improve the reliability of power supply and help maintain continuous station operations.
Multi-modal Connectivity	Both Nigerian stations rated Absent/Minimal on multi modal connectivity, both were designed primarily for private car access.	The proposed station would reflect the actual transportation pattern in Onitsha
Dedicated trade / cargo handling zone	None of the three case studies were rated comprehensive on commercial integration; none was purpose built for intercity trade corridor function.	Dedicated cargo facilities would enable the proposed station to directly support the movement of goods between Onitsha and Aba.
Passive day lighting and natural ventilation	Utrecht Centraal rated comprehensive on sustainability and Biophilic/ green criteria, versus absent/ minimal at both Nigerian station.	Incorporating natural lighting and ventilation into the Onitsha station would reduce dependence on artificial lighting and mechanical cooling, while improving the comfort of

Phased scalability in capacity planning	Utrecht Centraal's repeated historical reconstruction despite being an internationally- cited model station.	passengers and staff. Planning for future growth in passenger number.
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Source: Synthesis from case study analysis (2016)

DISCUSSION

Discussion of Key Findings

The findings of this study emphasise the need to reevaluate how train stations in Nigeria are designed, through the lens of environmental sustainability. Looking at the three case studies- Mobolaji Johnson Station, Obafemi Awolowo Station, and, as a point of contrast, Utrecht Centraal Station- a common pattern emerged in the two Nigerian cases: stations that function adequately for passenger comfort and capacity but are not designed to support environmental resilience, energy efficiency, or genuinely low-carbon mobility.

Existing literature already confirms that environmentally responsive design, passive lighting and ventilation, renewable energy integration, and multi-modal connectivity measurably improve station energy resilience, operational cost-effectiveness, and user comfort (Benoliel, Ferreira, & Matos Silva, 2023; Bagdade et al., 2025). Yet in the Nigerian case studies, these features were either absent or, in the case of Obafemi Awolowo Station, actively exposed as a point of operational failure. No renewable energy or passive design principles were found to be intentionally implemented in either facility.

Implication of sustainable design for train station function.

The findings of this study reveal that the absence of sustainable design in Nigerian train stations is not a result of resistance to the idea, but rather limited institutional awareness, weak professional integration of sustainability into infrastructure planning and budget prioritisation that favours visible capacity and comfort features. Train stations in Nigeria have historically been planned and constructed around passenger capacity and operational function, how many people a station can process, and how comfortable the waiting experience feels. However, a genuinely functional station requires more than seating capacity and air conditioning. It demands thoughtful design that acknowledges how the physical environment shapes the actual experience of the people who pass through it daily: commuters, traders, and staff alike. For a station like the one proposed for Onitsha, which must serve as a high-traffic trade and mobility hub, this sensitivity matters so much.

A station with sufficient natural daylight, effective natural ventilation, and well-planned circulation space is not a decorative luxury; it is a functional necessity for a facility expected to operate reliably under heavy daily use. Sustainable design features have been shown to directly improve station performance, reducing energy costs, improving air quality and thermal comfort and enhancing overall commuter experience. Just as importantly, these same design features benefit the staff who work within the station daily. In comparable indoor

workplace settings, well-lit and well-ventilated environments have been linked to improved comfort, reduced fatigue and better sustained productivity, while poor lighting and acoustic quality have been associated with physiological stress and health complaints among workers (Gabriel & Tavares,2023).

Recommendations for Stakeholders

1. Architects and professionals responsible for translating conceptual plans into actual architectural drawings and construction specifications should deliberately incorporate sustainable design elements, such as passive lighting, natural ventilation, and renewable energy integration, from the earliest design stage rather than treating them as optional additions. Doing so ensures that train stations not only look functional on paper but genuinely perform well and serve their users effectively once built, addressing the design gap identified across the Nigerian case studies examined in this study.
2. Institution (Nigeria Railway Corporation)

Institutions responsible for national rail infrastructure, such as the Nigerian Railway Corporation, should formally introduce sustainability principles into the design standards, procurement requirements, and planning guidelines governing train station development. Beyond individual projects, this should extend to supporting the integration of sustainability principles into architectural and environmental design education and professional training, ensuring that future infrastructure professionals enter practice already equipped to apply these principles consistently, rather than relying on isolated project-level initiatives.

3. Government and Non-governmental Organisations.

As this study emphasises, budget prioritisation, not lack of awareness, is a primary barrier to sustainable design adoption in Nigeria (Mba et al., 2024). Government bodies and supporting NGOs have a critical role to play in ensuring adequate and consistent funding mechanisms or incentives for sustainability-focused infrastructure initiatives.

Limitations of the Study.

The study is limited by its reliance on secondary data, small and carefully selected case studies, and varying levels of available information. Since Onitsha's proposed site is yet to be developed, site-specific validations were impossible. Additionally, differences in economic and institutional contexts limit direct application, while the framework remains untested.

CONCLUSION

This research set out to find out whether train stations can do more than just carry passengers from one place to another, specifically, whether they can also support trade, improve mobility

and reduce transport-related pollution. Using Onitsha as the focus of the study, the research examined documented evidence, existing literature, and observations to gather firsthand insights on the three train stations: Mobolaji Johnson Station, Obafemi Awolowo Station and the Utrecht Centraal Station, analysing their performance data and sustainability assessment to draw insights relevant to the proposed Onitsha train station.

The findings showed a clear pattern: both Nigerian stations are comfortable and accessible for passengers, but they were not designed with the environment in mind. Their architectural and infrastructural features remain environmentally rigid without any documented integration of renewable energy, passive design, or multi-modal low-carbon connectivity. A train station must do more than move people and process tickets; it must actively support the economic and environmental resilience of the community it serves. This study shows that across both Nigerian case studies examined, there is a clear disconnect between current station design and the trade and mobility needs of the communities they operate within. The Utrecht Centraal Station, by contrast, showed that sustainable, multi-modal, environmentally responsive station design is both achievable and beneficial.

This gives grounds for genuine optimism: the sustainability gap identified in this study is one that can be handled with institutional direction, adequate funding and deliberate implementation of the sustainability framework in newer train station infrastructure. This work invites professionals like architects, facility designers, railway institutions and policy makers to rethink how stations are designed to be as environmentally responsible as they are functional. The “Onitsha trade gateway” is offered as a starting framework for the shift: a train station model that closes this sustainability gap while also linking Onitsha and Aba as a sustainable trade and mobility corridor.

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