aurum

AURUM MÜHENDİSLİK SİSTEMLERİ VE MİMARLIK DERGİSİ
AURUM JOURNAL OF ENGINEERING SYSTEMS AND ARCHITECTURE

Cilt 9, Sayı 2 | Kış 2025
Volume 9, No 2 | Winter 2025

OPTIMIZING THE IMPACT OF CHINESE RAILWAY INVESTMENT ON INDUSTRIAL DEVELOPMENT: A COMPARATIVE STUDY OF NIGERIA AND GLOBAL BEST PRACTICES

Mohammed Auwal ABUBAKAR[1], Yavuz Çağlar CERŞİT[2]

[1] Department of Industrial Engineering, Altinbaş University, Istanbul, Turkiye, awadkabs@gmail.com
https://orcid.org/0009-0006-7097-7839)
[2] Department of Industrial Engineering, Aydin University, Istanbul, Turkiye. ccersit@gmail.com
(https://orcid.org/0000-0002-8965-4048)

Received: 01.07.2024
Accepted: 26.11.2025
Published: 31.12.2025
*Corresponding author

Research Article
pp.197-216

DOI: 10.53600/ajesa.1506889

Abstract

The impact of Chinese railway investments on industrial development is a subject of considerable interest and debate, particularly in emerging economies like Nigeria. The primary goal of this article is to qualitatively examine the strategic/political, economic, and social effects of Chinese engagement in developing Nigeria's railways. Relying on open sources ranging from press reports, and scholarly works, to unclassified official records, the study investigates Chinese financing and construction of Nigeria's railway system in the 21st century. The study contributes to the body of research questioning whether the economic cooperation between the People's Republic of China PRC and Nigeria is to the latter's detriment. The findings highlight the importance of good governance and planning in maximizing the benefits of railway investments for industrial growth. It also discussed the importance of collaborating with international bodies to achieve the success of the Nigerian Railway sector, moreover, the study looked into how easily Nigeria can optimize the development of Chinese Investment within its terms and conditions. The article suggests mutual or win-win cooperation between the two countries.

Keywords: Railway Investment, Economic Growth, Chinese Investment, Industrial Development, Transportation Infrastructure

ÇİN DEMİRYOLU YATIRIMLARININ ENDÜSTRİYEL KALKINMA ÜZERİNDEKİ ETKİSİNİN OPTİMİZASYONU: NİJERYA VE KÜRESEL EN İYİ UYGULAMALARIN KARŞILAŞTIRMALI BİR ÇALIŞMASI

Özet

Çin demiryolu yatırımlarının endüstriyel kalkınma üzerindeki etkisi, özellikle Nijerya gibi gelişmekte olan ekonomilerde önemli ilgi ve tartışma konusudur. Bu makalenin temel amacı, Çin'in Nijerya demiryollarının geliştirilmesindeki katılımının stratejik/politik, ekonomik ve sosyal etkilerini nitel olarak incelemektir. Basın raporlarından ve akademik çalışmalardan sınıflandırılmamış resmi kayıtlara kadar açık kaynaklara dayanan çalışma, 21. yüzyılda Çin'in Nijerya demiryolu sistemini finanse etmesini ve inşa etmesini araştırmaktadır. Çalışma, Çin Halk Cumhuriyeti (ÇHC) ve Nijerya arasındaki ekonomik işbirliğinin Nijerya'nın aleyhine olup olmadığını sorgulayan araştırmalara katkıda bulunmaktadır. Bulgular, endüstriyel büyüme için demiryolu yatırımlarının faydalarını en üst düzeye çıkarmada iyi yönetişim ve planlamanın önemini vurgulamaktadır. Ayrıca, Nijerya Demiryolu sektörünün başarısını sağlamak için uluslararası kuruluşlarla iş birliğinin önemi tartışılmıştır; ayrıca çalışma, Nijerya'nın Çin yatırımının gelişimini kendi şartları ve koşulları dahilinde ne kadar kolay optimize edebileceğini incelemiştir. Makale, iki ülke arasında karşılıklı veya kazan-kazan iş birliğini önermektedir.

Anahtar Kelimeler: Demiryolu Yatırımı, Ekonomik Büyüme, Çin Yatırımı, Endüstriyel Kalkınma, Ulaşım Altyapısı

1. INTRODUCTION

The attention to increasing infrastructure investment in the transportation network has been drawn from various factors in modulating industrial development patterns in the current global economic views. Nigeria is one of the countries in Africa that needs to address the issues and lack of infrastructural development, in this regard, Chinese railway investment is one of the essential trends driven by its efforts such as the Belt and Road initiative to connect different regions economically. Nigeria is Africa's most populous and largest economy and needs to grow strongly to tackle its railway sector to diversify the economy and get rid of poverty (Yeboua, Cilliers, & Alize, 2024). Moreover, boosting railway investment will help bring more opportunities for trade and industrial growth and solve critical challenges facing the Nation. This article will discuss the complications and solutions of Chinese railway investments in Nigeria and best practices from around the world by qualitatively getting some findings from various sources such as journals, reports, scholarly sources, books, and academic databases.

2. BACKGROUND/ LITERATURE REVIEW

Nigeria's railway system has a rich historical legacy, dating back to the colonial era, while China boasts one of the world's most extensive and advanced railway networks. Railway infrastructure is crucial for economic development, enabling efficient movement of goods, fostering trade, and stimulating industrial growth. China's primary interest in Nigeria stems from the country's enormous raw mineral deposits, strong market potential, and investment track record in Africa (Onyekwena & Oloko, 2016). Nigeria is a major oil producer outside the Middle East; this particularly makes China accord Nigeria special attention in their economic cooperation. China and Nigeria share some common attributes. Both countries happened to be the most populous nations and holders of the largest economies in Asia and Africa, respectively (Taylor, 2018). The World Bank revealed in 2021 that China's GDP stood at $17.7 trillion, while that of Nigeria was at $440.8 billion (World Bank, 2022). Since the beginning of the 21st century, the PRC has increased commercial activities in Nigeria because CCP leaders identify the country as one of the geostrategic and vital business destinations in Africa with which to engage as a global power. The start of major commercial ties between China and Nigeria dates back to 2001 when the two countries made agreements for Chinese oil companies to operate in Nigeria's oil and gas sector (Onyekwena et al., 2019).

The increased economic involvement of African countries through the PRC has attracted mixed reactions from different camps. Supporters of China's involvement in Africa see China as the continent's champion of economic development, while China's critics argue that China is economically "recolonizing" African countries including Nigeria. Historically, the PRC's foreign policy focused primarily on encouraging African countries to resist Western colonialism (Brautigam, 2010). After the Cold War, China increasingly shifted its focus to

deepening relations with developing countries, especially Africa. Nevertheless, research shows that China's interest in Nigeria is aimed at fulfilling Beijing's four main interests concerning Africa, politically, philosophically, security-wise, and trade. It has been suggested that (Yun Sun, 2014). Formal ties between the PRC and Nigeria were cemented in 1972 when Chinese and Nigerian representatives reached an open-ended agreement for technical trade and economic cooperation. Between 1972 and 1999, the Sino-Nigerian Economic relationship was modest, especially due to political volatility in Nigeria (Adewumi & Akinnuga, 2021). With the return of a civilian administration in Nigeria, relations improved steadily from around 2000. Another key enabling factor for their developing relationship at that time was the PRC's rejuvenation of its foreign policy toward cooperation with Africa, as embedded in the framework of the Forum on China-Africa Cooperation (FOCAC). Railway systems are essential in contributing to economic development, especially when considering collaborative efforts between Nigeria and China. These findings looked into the focal point between railway infrastructure and economic progress, focusing on optimization strategies within the context of Nigeria-China collaboration.

2.1 Brief History

This section will give some insight into the historical context of Nigeria's railway sector and the benefit it gets from Chinese investment. Nigeria's railway system was first started by the British colonial regime back in the year 1896 the first railway construction began in the year 1898 in the city called Iddo in Lagos in the southern part of the country.

The second phase started in a city called Abeokuta and reached Ibadan in 1901, which covered a distance of about 190km.

Moving forward, in the early 1960s, the Nigerian railway was able to carry an average of 12 million passengers annually (Ayoola, 2023). The British colonial government took hold of it until the year 1955 when the Nigerian came into power. It later became known as Nigeria Railway Cooperation (NRC) until to date.

2.1.1 Bilateral Cooperation

Nigeria gained Independence in 1960, but the bilateral cooperation between Nigeria and China began years after Nigeria's independence due to issues concerning the two governments. A diplomatic tie was officially signed by the year 1971 (Agubamah, 2014). Chinese financing often comes in the form of loans with stringent repayment terms. Excessive borrowing from China could lead to a debt trap, where Nigeria becomes heavily indebted and struggles to meet repayment obligations, potentially compromising its financial sovereignty.

Nigeria's outstanding loans from China stood at about $3 billion (China Exim, 2020). Most of the loans have a tenure of between five and 20 years and are payable with interest rates ranging from 2.5 percent to 3 percent (Debt Management Office, n.d.). While the interest rates seem modest, the gestation term is fairly prolonged for developmental projects, and also above average

for financing third-party projects in a developing country like Nigeria. As of now, many economic analysts, government officials, and other global as well as regional organizations have expressed in the long run.

Fig 2.1 Railway System of Nigeria, 2021

An illustration in Fig 2.1 shows us the Nigerian Railway system across the country, the first construction started from the south linking the South-East to the North-East. Constructions have been going on to link up the remaining regions.

2.2 Approach Process

Nigeria should implement policies aimed at promoting local content in railway construction projects. This involves incentivizing the development of domestic industries and manufacturing capabilities to produce railway components, equipment, and technologies locally. Also by reducing dependency on imported technology, Nigeria can enhance self-sufficiency, create employment opportunities, and stimulate economic growth (Agbiboa & Ojonta, 2019).

2.2.1 Asset Optimization Process

Optimizing asset lifecycle management is critical to ensuring Nigeria's railway infrastructure's efficiency, reliability, and longevity. The need to Develop risk management processes to identify, assess, and mitigate risks to rail assets, including natural disasters, cyber threats, and service interruptions. Implement resilience planning measures to improve the robustness and adaptability of rail infrastructure in the face of changing environmental and operating conditions.

2.2.2 Tech Transfer Processes

While technology transfer is a potential benefit of Chinese investment, it could also lead to dependency on Chinese technology and expertise. This could limit Nigeria's ability to innovate and develop indigenous capabilities in railway technology and management. The dominance of Chinese technology suppliers in Nigeria's railway projects may lead to a loss of technological sovereignty, where critical infrastructure decisions are dictated by external actors. This poses risks in terms of data security, intellectual property rights, and control over strategic assets. China now has more investments in several non-oil sectors of Nigeria, such as agriculture, telecommunications, manufacturing, power generation, rail, road, and airport infrastructures (Jackson, n.d.). Power infrastructure and generation in Nigeria have been a major challenge for many years. In 2006, China provided about $3.5 billion for the construction of five hydroelectric dams, representing an aggregate of 6000 megawatts capacity across Nigeria. By the end of 2023, the China Civil Engineering Construction Corporation (CCECC) is also expected to complete another huge hydropower plant in Nigeria, costing about $5.8 billion, with China’s Import-Export Bank providing 85 percent of funding for the project (Campbell, 2022). In the technical sector.

Figure 2.2 The Lagos-Ibadan double-track standard-gauge Nigeria, 2023

The above Fig 2.4 shows the rate at which technology transfer can be achieved to optimize the development of the railway system in a short time. The Lagos-Ibadan railway line became officially active to passengers in June 2021 with about 157 km long line and a 150 km/h speed. The passenger traffic crossed over 2 million as of March 2024 (Lagos Railway, 2023)

2.2.3 Technological Advancement

Collaboration with China enables Nigeria to access state-of-the-art railway technologies and innovations, including high-speed railway and digital signaling systems. Embracing technological advancements enhances operational efficiency, safety, and passenger experience, positioning Nigeria's railway system for sustainable growth. The 2001 treaty for enhanced economic ties has significantly bolstered Sino-Nigerian bilateral trade (Aisien & Adesuwa, 2019). According to the Harvard University Observatory of Economic Complexity's database, the total trade value recorded between China and Nigeria in 2000 was $561.6 million, and it peaked at a total of $19.9 billion by 2020 (China-Nigeria Trade, 2022).

Table 2.1 A breakdown of data on the Railway Transportation System in Nigeria. 2023

Quarter	Passengers	Revenue from the cargo in USD	Revenue from Passengers in USD	Goods/cargo in Tons
Q1	441,725	181,270,800	768,438,658	59,966
Q2	474,117	188,028,350	1,100,941,295	56,029
Q3	594,348	286,775,780	1,489,200,328	81,963
Q4	672,198	423,215,481	1,067,915,479	119,286
Total	2,182,388	1,079,290,411	4,426,495,760	317,244

Source: NBS

Nigeria's road networks often suffer from congestion, especially on major highways and urban routes. As a result, businesses may opt for rail transport to avoid delays and disruptions associated with road congestion. Railways offer a more predictable and efficient means of moving goods, particularly over long distances.

Nigeria has partnered with China to restore its railway sector, leveraging Chinese expertise, technology, and financing to modernize infrastructure and expand the network. Chinese companies, backed by government support, have been instrumental in executing major railway projects in Nigeria.

PRC-Nigeria relations are economically connected by trade, provision of loans, financial aid, and investments. Meanwhile, Nigeria's need for urgent solutions to address the country's infrastructure gaps makes the PRC's investments in infrastructure and financing approach to developing countries rather attractive. China's lending agreements without imposing rigorous settlement terms, as well as its seeming non-intervention principles in any host country's domestic affairs, also build an enabling environment for the Sino-Nigerian economy.

2.2.4 The Benefit of Railway Enhancement Using Tech

Technological advancements and innovation play a crucial role in transforming Nigeria's railway sector, enhancing efficiency, safety, and passenger experience. This section explores key advancements and innovations shaping the modernization of Nigeria's railway infrastructure.

Some of the rail systems have been connected to comm. systems also as the electrification. A successful railway network can develop access to spread ease tasks and the execution of rural telephony alongside the electrification and initiatives persists as a measure. Should the implementation be achieved with exact contributors to National employment statistics? Starting from the foundation phase of rail-laying, extending through the difficulties of station construction, the assembly of rolling stocks and carriages, all the way to the operational logistics and diverse employment opportunities that can manifest. These include, but are not limited to role spanning engineers clerks, managers, ticket printing professionals, legal experts, medical practitioners, financial accountants, surveyors, casual labor forces, and educators.

The capacity for job creation within this sector is endless. It is to be noted that railroad transport stands as a primary employment generator internationally. Data from various timelines and geographics underscore this assertion, the Polish railways, in the year 1992, accounted for 276, 000 employed persons while the Japanese National Railways maintained a workforce of 415,000 in the year 1980, which saw a reduction to 281,000 pre-privatization; and the Nigerian Railway Corporation supported over 46,000 jobs at the end of 1970s (Global Railway Industry, 2023).

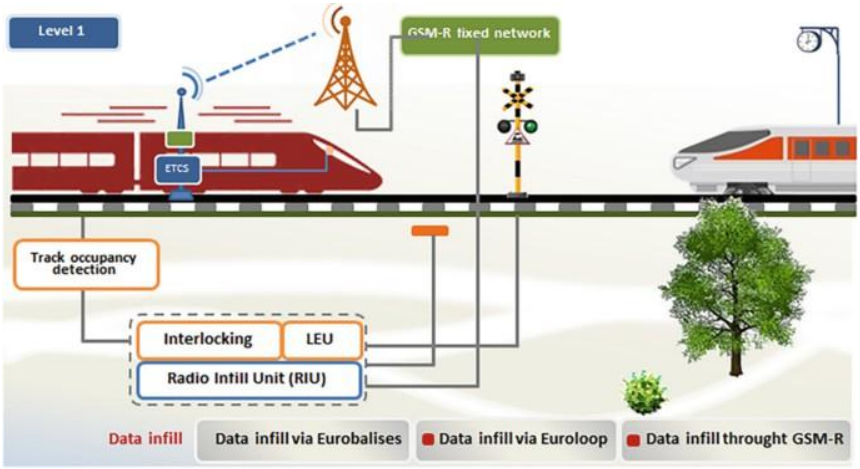

Figure 2.3 The use of IT in Railway Transport 2022.

As shown in Fig 2.3 The benefit of rail transportation lies in its capability to transport large quantities of goods across long-range distances on a routine basis. The railway industry leverages information technology like the

other transportation sectors to uphold strong service quality and circumvent hindrances. The realm of rail transportation encompasses a diverse array of information systems, encompassing managerial and technical safety components, and the enhancement of process efficiency through the orchestration of an assortment of systems and technologies, among other aspects.

3. METHODOLOGY

The study acquired a unique methodology through findings, research from various sources, and data collection from both countries. The reader would be able to know which steps and ideas were followed in performing the assessment. This article aims to discuss how Nigeria can benefit more from Chinese railway investment and how to optimize it by following global best practices. Literature studies were carried out to make it more understandable. Methods used in this research will contribute to finding solutions to the Nigerian Railway networks.

3.1 A CASE STUDY

The case study in this selection discusses the influence and presence of China's railway investment on the development and industrialization of railways in Nigeria. Africa's largest economy, Nigeria benefits from the ongoing Chinese investment projects and vice-versa. The case study identifies Nigeria as a nation with less of a strategic policy to find solutions to the problems and challenges facing the infrastructure of railways in the country.

3.1.1 Research Questions

Qi. What is the main reason behind the decline of railway infrastructure in Nigeria?
Qii. How effective is the quality of China's construction of railways in the 21st century? Qiii. To what extent can Nigeria improve its experience following global best practices? Qiv. What factors can contribute to the industry's maintenance culture?

Finding answers to these questions will help navigate the Nigerian railway sector's challenges. China is one of the leading developers and also the financier of effective infrastructure in the continent of Africa, China gets in return natural resources, and raw materials to boost its economy.

3.2 MODELS PROPOSALS

The study follows models that will navigate the development of railways in Nigeria and Africa through some analysis and approach from global best practices. The rail industry has been projected to be the best globally because it generates revenues daily. This research presents an approach to data modeling techniques in the operation of the railway system and its maintenance.

3.3 THE POLITICAL ASPECT

To highlight some aspects, the Chinese Communist Party leaders have used state-owned industrial technology resources in the form of railway construction and concessional loans to further their foreign policy and secure China's energy needs in Nigeria. Meanwhile, Nigerian politicians are also using China's railway project to gain political support. Although China's involvement in the railway sector has made a small contribution to achieving Nigeria's medium-term economic goals, the loans received by China to finance railway construction are gradually putting pressure on the country's national budget. On the social front, the Chinese-made train has facilitated the movement of some middle-class commuters, but the relatively high price of train tickets for the average Nigerian makes the train cost-effective. doesn't seem to be effective. Overall, China appears to have benefited more from Chinese rail projects than Nigeria. The construction and investment of railways in Nigeria faced huge Political hindrances in Nigeria, thus China’s effort to gain more investment needs to play her role to succeed.

3.4 COMPARING RAILWAYS AND ROADS

SWOT analysis was conducted to describe the Strengths, Weaknesses, and Threats concerning railways vs roads. This analysis gives us insight into the analysis between the two factors. Below is an illustration of the SWOT Analysis

Table 3.1 SWOT Analysis

Strength	**Weakness**
Economic growth Regional integration Cheap, safe and eco-friendly Social development	Limited coverage Infrastructure maintenance Regulatory constraints Lack of Financial resource
Opportunity	**Threat**
Technological innovation International collaboration Policy reform Market growth potential	Competition from road transport Environmental challenges Absence of real-time policy Political instability

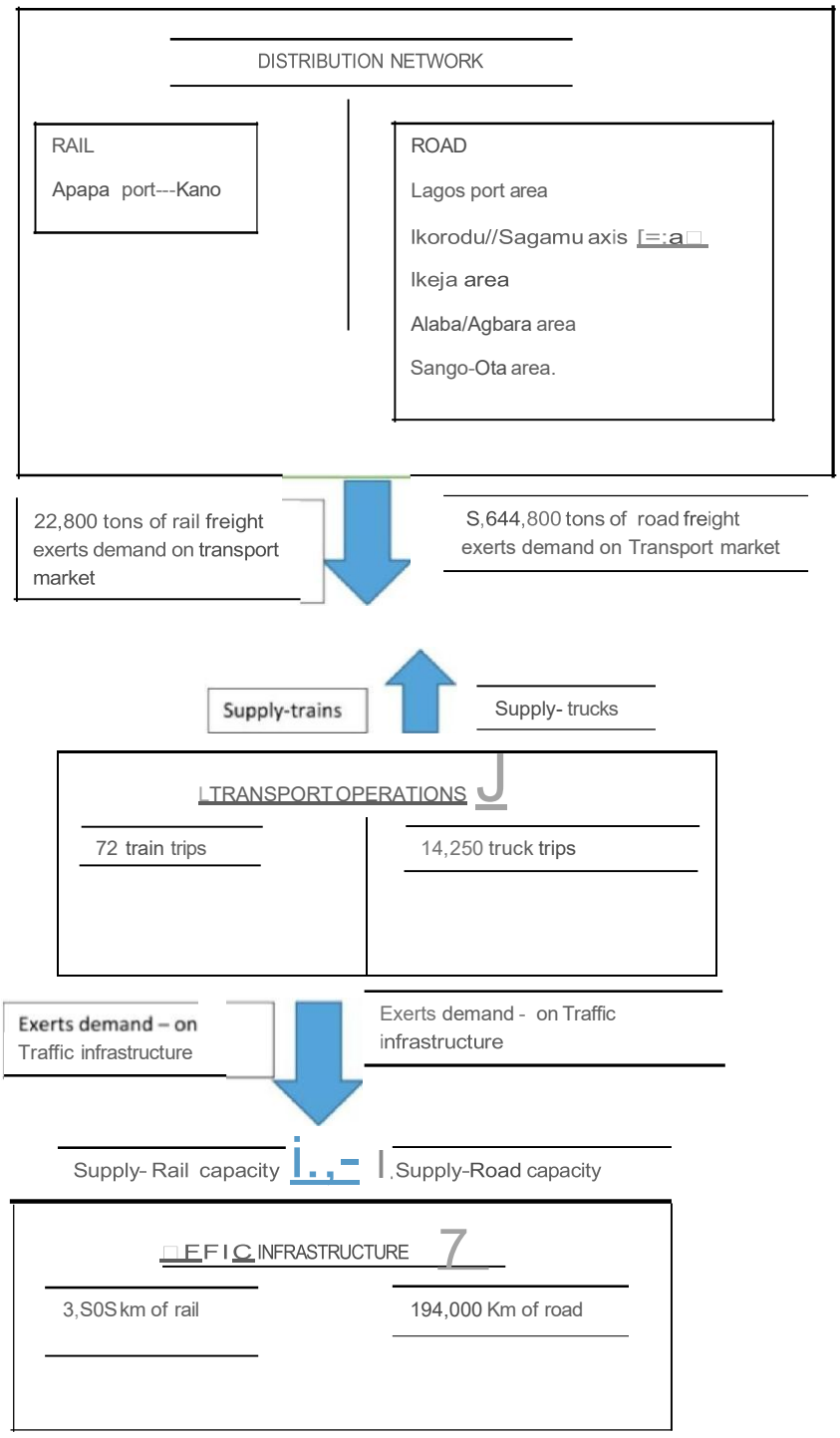

Figure 3.1 Rail VS Road distribution network in Nigeria

The above figure describes the effect of road and railway distribution networks. The Kano to Apapa port rail line transports approximately 22.800 tons of goods daily while road transport accumulates 5.644.800 tons of goods and products. This illustrates the lack of a rail line network in Nigeria. The train supplies less than the road.

3.5 QUALITY DEVELOPMENT

Development of Nigeria's Railway system should follow National development standards through the findings of global best practices. This will help establish a unique way to enhance technology in the railway sector. Leading railway systems prioritize eco-friendly technologies such as regenerative braking systems, energy-efficient rolling stock, and sustainable materials in infrastructure construction. This section will look into some models that will help in the optimization of industrial development on Chinese investment. While Embracing environmentally friendly practices and technologies, The minimization of its carbon footprint mitigates environmental impact and contributes to global sustainability goals. Despite having abundant natural and human resources, an infrastructure deficit continues to pose an impediment to Nigeria and Africa, hindering the realization of the continent's fullest economic growth potential. The existing infrastructure in some African countries was built under European colonialism. Most of these structures have further deteriorated often due to neglect under administrations in post-colonial periods or were damaged during domestic conflicts or civil wars (Alves, 2023). Besides, low rates of domestic investment in these infrastructures have rendered them undeveloped and incapable of addressing the issues. In addition to the dearth of necessary public funding to develop key infrastructure, some African countries are guilty of poor financial management and low credit scores in the international market.

The Implementation of rigorous quality assurance and development standards, and compliance mechanisms to ensure that railway infrastructure meets technical specifications, safety requirements, and international best practices. A description of conducting an independent audit, inspections, and assessments to verify the quality and integrity of construction work and address any deficiencies promptly through various sources was conducted. Constructed with little consideration for the potential social benefits of the railway for adjoining communities, the narrow-gauge tracks were economical in connecting passengers and freight between the northern and southern regions of the country. Establishing local factories and manufacturing steel to make rail tracks will have an assurance of quality development.

The Nigeria Minister of Transportation, Senator Said Alkali has said the Kano- Maradi rail project when completed would facilitate trade and boost bilateral relations between Nigeria and Niger. Foster constructive dialogue and engagement with affected communities, local authorities, and civil society organizations to address concerns, solicit feedback, and promote inclusive decision-making. Incorporate community input into project design, planning, and mitigation measures to minimize social conflicts, displacement, and adverse impacts on livelihoods. Shortly

after the RITES and "Ogbemudia Revolution" efforts to rejuvenate the NRC, the Nigerian government turned to China to improve its rail infrastructure. In 1995, the CCECC was awarded a $528,697,000 three-year contract for the repair, repositioning, strengthening, and reduction of the sharp bends along Nigeria's railway tracks (Akwara, Udawa, & Ezirim, n.d.). The contract obligated Chinese companies to supply rolling stocks, wagons, locomotives, and coaches to the NRC. At the expiration of the contract period in 1998, the CCECC was, however, unable to meet all its obligations, with only minor improvements to the railways being made. In 2002, the Federal Government of Nigeria adopted a 25-year strategic plan that internationally acceptable standards (Nigeria Railway, 2002). According to the plan, the "colonial-era built" narrow-gauge (1,067 mm) tracks were to be reformed into standard-gauge (1,435 mm) The 36 states and economic focal points in Nigeria. The plan was also projected at a total cost of $60 billion: 20 percent of the funding was to be provided by the government, while the remaining 80 percent would be sourced from local and foreign investors. Public-private partnerships (PPP) option helps to improve the overall quality of service of the railway transport system.

3.5.1 Long-Term Maintenance and Operation

Drawing inspiration from China's renowned expertise in railway infrastructure, Nigeria can implement comprehensive long-term maintenance and operation strategies to ensure the sustainability and efficiency of its railway network. Develop comprehensive maintenance and operation plans to ensure the long-term sustainability and efficiency of railway infrastructure beyond the construction phase. The Investment in training, equipment, and infrastructure for maintenance crews, establishing maintenance schedules, and allocating sufficient budgetary resources for ongoing upkeep and repairs. China's extensive experience in railway infrastructure development provides valuable insights into long-term maintenance and operation strategies that can be applied to Nigeria's railway sector.

The Implementation of performance-based contracts in railway maintenance incentivizes contractors to achieve specific performance targets related to uptime, reliability, and customer satisfaction. Emulate China's success in driving efficiency and quality improvements through performance-based contracting mechanisms. The immediate or distant future. Sustainable transport systems align economic growth with social and environmental priorities as they provide the physical networks and services upon which a nation depends.

Chinese companies are responsible for project execution and management, and overseeing various aspects of construction, procurement, and quality control. The company brings firm expertise in large-scale infrastructure development, ensuring timely completion and adherence to technical specifications. The technology to assist the system in solutions to problems requires models that allow the capacity engines to work efficiently.

3.5.2 Optimization Factor Global Practice

Railway integration between Europe and Asia has led to a significant increase in trade volume and economic growth along the transcontinental corridors. The efficient movement of goods and passengers has stimulated economic activity in regions connected by railways, fostering trade partnerships and attracting investments. Standardization and harmonization of railway infrastructure play a crucial role in facilitating seamless cross-border operations.

Global best practices emphasize the adoption of common technical standards, interoperable signaling systems, and uniform safety regulations to ensure smooth and efficient railway connectivity between Europe and Asia. Efforts such as the European Train Control System (ETCS) and the Trans-European Transport Network (TEN-T) aim to promote interoperability and streamline cross-border operations (European Commission, 2019). Several countries and regions have initiated various projects and strategies to enhance railway integration between Europe and Asia, incorporating global best practices in the process.

Turkiye is recognized for its significant advancements and modernization efforts in railway infrastructure, positioning itself as one of the countries adopting global best practices in railways. It has invested substantially in developing a high-speed rail network, connecting major cities across the country. The Ankara-Istanbul high-speed railway, for instance, is one of the flagship projects, reducing travel time between the two cities significantly. This initiative aligns with global best practices in promoting fast, efficient, and sustainable intercity transportation. As the network continues to expand, it is expected to play a critical role in Turkiye's long-term infrastructure strategy.

Policymakers should emphasize data-driven decision-making in maintenance planning and asset management, leveraging data analytics, predictive modeling, and asset management systems to optimize maintenance strategies and resource allocation. Follow China’s lead in utilizing data-driven insights to enhance the Nigerian Railway sector in maintenance and efficiency control. It will also reduce costs, and improve asset reliability.

3.5.3 Section Overview

The overview of this chapter described the methodology used in assessing this article's paperwork to the goal and objectives of this research. Questions were asked to help identify the problems and find a solution through this chapter’s methodology. The study case is being reviewed thoroughly to help find the benefit of using technology in the development of railways, in a nutshell, decision-making is vital to achieve these aims and values. International railway case studies offer Nigeria valuable insights into its infrastructure development. The lessons provide insights into optimizing Chinese railway investments by examining successful projects in other countries. These nations have embraced innovative strategies such as electric railways, high-speed rail, modernized facilities, and transparent partnerships with China.

4. RESULT

This is the second to the last section/chapter of this article's research work. First and foremost, the article writing began with an introduction and reviewing the literature, study case, and investigation through which the work gap could be identified solutions to the problems. An analysis of different aspects of the topic has been thoroughly analyzed.

These factors are key impediments to Africa's infrastructural development. Historically, some African regimes have funded the [re]construction of key national infrastructure, but the private sector stakeholders are largely unable to provide the required loans or funding to sustain long-term investments in infrastructure development. Given the pace of globalization as well as the rising global demand for Africa's naturally endowed mineral, its existing infrastructure. Initiatives like the Programme for Infrastructure Development in Africa (PIDA) and the G20 Compact with Africa have been focused on supporting infrastructure development in Africa with significant lending and financing arrangements (Priyadarshi Dash et al., 2021). In the same vein, the infrastructure gap in Africa provides significant opportunities for foreign investors like China and its state-owned enterprises (SOEs) to finance and construct capital infrastructure assets, including roads, power plants, railways, and ports across the continent.

Countries with successful railway systems often prioritize integrated transportation planning, where railways are seamlessly connected with other modes of transport such as buses, trams, and metros. This approach ensures efficient and convenient travel options for passengers, reduces congestion on roads, and promotes sustainable urban development (Kim & Patel, 2019). The adopting and adapting these global best practices to local contexts, countries can achieve sustainable, efficient, and inclusive railway systems that contribute to economic growth, environmental protection, and social development.

4.1 ARTICLE FINDINGS

This article follows a pattern that will enable its readers be able to differentiate between railway investments and roads, the method for the research was done using data collection methods such as qualitative analysis with a small consideration of quantitative analysis, going through online sources to find solutions to the problems facing Chinese investment in Nigeria. Nigerian railway projects often need to improve infrastructure quality and adherence to international standards compared to global best practices. This includes track quality, signaling systems, station facilities, and overall operational efficiency. Addressing these gaps is crucial to ensuring safety, reliability, and interoperability with international railway networks.

Global best practices emphasize the integration of modern technologies into railway systems to enhance efficiency, safety, and passenger experience. However, Nigerian railway projects often lack advanced technological solutions such as automatic train control, real-time monitoring systems, and predictive maintenance

algorithms. Embracing innovative technologies is essential to modernizing Nigeria's railway infrastructure and improving overall performance (International Association of Public Transport, 2018). The study aims to bring out essential findings and recommendations on optimizing the impact of Chinese railway investment in Nigeria and Africa. This article looked into some data from various sources such as academic literature, government reports, and industry publications to provide a comprehensive understanding of the topic to provide findings on the Opportunities and Challenges of Chinese Investment in Nigeria's Railway Construction," comprehensive research and analysis would be required. This could involve examining various aspects. Efficient railways facilitate the movement of goods within Nigeria and also serve as crucial links for international trade.

4. 1. 2 The Significance

The research discussed the importance of railway investments in the 21st century. It is highly encouraging for nations to adopt railway systems and optimize their infrastructure according to global best practices. As seen in the previous chapters, Nigeria and China collaborate in the revitalization of the railway sector of the country which in return yields significant revenue generation. Furthermore, the rail system is more cost-effective than traditional roads. This signifies the advantages and socio-economic developments.

International railway case studies offer Nigeria valuable insights into its infrastructure development. The lessons provide insights into optimizing Chinese railway investments by examining successful projects in other countries. These nations have embraced innovative strategies such as electric railways, high-speed rail, modernized facilities, and transparent partnerships with China.

4.1.3 Challenges And Concerns

Despite the opportunities presented by Chinese investment, several challenges and concerns accompany the implementation of railway construction projects in Nigeria. These include issues related to debt dependency, where extensive borrowing from China may lead to debt sustainability challenges and potential loss of financial sovereignty (Olukotun & Akinpelu, 2020). Additionally, concerns about the quality of infrastructure, environmental impact, social displacement, and limited local participation raise questions about the long-term sustainability and inclusivity of railway development initiatives.

While Chinese technology may offer initial cost advantages, long-term dependency could result in higher costs associated with maintenance, upgrades, and licensing fees.

Nigeria can leverage public-private partnerships (PPPs) to foster technology innovation and research in the railway sector. Collaborating with private sector entities and research institutions can accelerate the development of indigenous technologies and solutions tailored to Nigeria's specific needs.

5. DISCUSSION AND CONCLUSION

5.1 DISCUSSION

Nigeria should adopt a risk-based approach to prioritize maintenance and renewal activities and assess factors like asset criticality, consequence of failure, and probability of failure, so resources can be allocated where they are most needed. This approach ensures that critical assets receive adequate attention, minimizing the risk of disruptions and ensuring operational reliability. Establishing a culture of continuous improvement is important for refining asset management practices over time. Regular reviews and adaptation to technological advancements and changing regulatory requirements ensure that strategies remain relevant and effective. This adaptive approach enables Nigeria to stay at the forefront of asset management best practices.

In conclusion, optimizing asset inventory and condition assessment practices is crucial for the sustainable development and efficient operation of Nigeria's railway infrastructure. By getting some inspiration from global best practices and leveraging lessons learned from China's experience, Nigeria can enhance its asset management capabilities, ensuring the reliability, safety, and longevity of its railway network for generations to come.

5.1.1 RECOMMENDATION AND FUTURE WORK

Based on the research and findings being conducted, it is recommended that future researchers make some findings on the concept of high-speed railway investment in Nigeria. To also focus on the manufacturing plants of steel production factories, the steel factory is the main subject of the development of rail tracks.

The future is bright, more discoveries should be made for the betterment of humanity.

5.2 CONCLUSION

To sum up everything, the article contains chapters, and each chapter explains rigorously the topic matter, the main focus of this paperwork is to attract more researchers and reviewers to help identify the difficulties in railway industries, optimization model, risk management, and the use of advance technology in railway industries can bring positive solution to the sector.

The Chinese investors are moving at a speed to change the narrative on the development of railways in Nigeria and Africa. Nevertheless, Governments should investigate these firms first before embarking on any kind of contract. It has to be a win-win agreement for both countries. We have seen countries falling into debt traps, this action needs to be done under strategic circumstances.

REFERENCE

Agbiboa, D. E., & Ojonta, O. D. (2019). "China's Belt and Road Initiative, Africa's new railroads and the Sino-Nigerian bonanza." Geopolitics, 24(2), 354-377.)

Agubamah, E."Bilateral Relation: Periscoping Nigeria and China Relation. *European Scientific Journal,* 2014. 10(14).

Akwara, Udaw, and Ezirim, "Adapting Colonial Legacy to Modernism.

https://www.researchgate.net/publication/281677900_

Adapting_Colonial_Legacy_to_Modernism_A_Focus_on_Rail_Transport_Development in_NigeriaAna

Cristina Alves, "China's 'Win-Win' Cooperation: Unpacking the Impact of Infrastructure-for-

Brautigam, D., "The Dragon's Gift: The Real Story of China in Africa," *Journal of Contemporary China*, vol. 19, no. 65, pp. 101-114, 2010

China-Nigeria Trade Relations Over Two Decades," *Journal of International Economics and Trade Relations*, vol. 17, no. 4, pp. 85-100, 2022.

Debt Management Office Nigeria https://www.dmo.gov.ng/

E. Kim and F. Patel, "Geopolitical Implications of Railway Integration: Case Studies from Europe and Asia," IEEE J. Glob. Aff., vol. 12, no. 4, pp. 345-360, 2019.

Employment Trends in the Global Railway Industry," *Journal of International Railway Economics*, vol. 19, no. 4, pp. 76-91, 2023

European Commission. (2019). "Railway Innovation: The European Railway Sector's Vision for Research & Innovation." European Union.)

Eyitayo Folasade Adewumi and Samuel Oluwatobiloba Akinnuga, "Beyond Rail Revolution:
from-china-exim-as-at-march-31-2020.

https://www.brookings.edu/wp-content/uploads/2016/06/Africa-in-China-web_CMG7

indicator/NY.GDP.MKTP.CD?end=2021&name_desc=true&start=2021&view=bar.

International Association of Public Transport. (2018). "Integrated Mobility Solutions: Best Practice Examples from Around the World." UITP.)

Jackson, "Two Distant Giants

https://www.wathi.org/two-distant-giants-china-and-nigeria-perceive-each-other/

John Campbell, "China Gives a Dam," Council on Foreign Relations, accessed August 5, 2022, https://www.cfr.org/blog/china-gives-dam.

Kouassi Yeboua, Jakkie Cilliers and Alize le Roux (2024) Nigeria. Published online at futures.issafrica.org. Retrieved from https://futures.issafrica.org/geographic/countries/nigeria/

Lagos-Ibadan Rai lway: Enhancing Connectivity and Economic Growth," *African Infrastructure Research Journal*, vol. 15, no. 2, pp. 35-50, 2023.

Leonard Nosa Aisien and Erediauwa Adesuwa, "Impact of Chinese Trade and Investment on Nigeria's Economic Growth," International Journal of Humanities and Social Science 9, no. 7 (July 2019): 136–48, https://doi.org/10.30845/ijhss.v9n7p17.

Olukotun, A., & Akinpelu, A. (2020). "Chinese loans and Africa's railways: Implications for development." Journal of Sustainable Development in Africa, 22(1), 25-44.)

Onyekwena, C., & Ekeruche, M. A., "Nigeria and China: Development or Dilemma?" *Center for the Study of the Economies of Africa*, 2019

Onyekwena, C., & Oloko, M., "China-Nigeria Economic Relations and the Challenge of Diversification," *Center for the Study of the Economies of Africa*, 2016.

Priyadarshi Dash et al., G20 Support for Improved Infrastructure Project Cycles in Africa (G20 Insights Platform, 2021), https://www.g20-insights.org/policy_briefs/g20-support-for-improvedinfrastructure-proje ct-cycles-in-africa/.

Resources Deals in Africa," South African Journal of International Affairs 20, no. 2 (2013): 207–26, https://doi.org/10.1080/10220461.2013.811337.

Rethinking Nigeria-China Relations for the Next Decade," KIU Journal of Humanities 6, no. 2 (2021): 33–39.

Status of Loans Obtained from China Exim as of March 31, 2020," Debt Management Office Nigeria, August 6, 2020, https://www.dmo.gov.ng/debt-profile/external-debts/3220-status-of-loansobtained-Taylor, I., "China's Global Engagement and its Impact on Africa," *Journal of Contemporary China*, vol. 27, no. 111, pp. 859-872, 2018.

Tokunbo Aderemi Ayoola , "Nigeria wants to revamp its railway network. Four things it needs to do to succeed. ''*The conversation''* October 15. 2023

Yun Sun, Africa in China's Foreign Policy (Washington, DC: Brookings, 2014),

"GDP (Current US$)," World Bank Data, accessed July 29, 2022, https://data.worldbank.org/ "Nigeria Railways' 25-Year Timetable," BBC News World Edition Africa, November 14, 2002,http://news.bbc.co.uk/1/hi/world/africa/2476963.stm.