



THE Consulting Engineer

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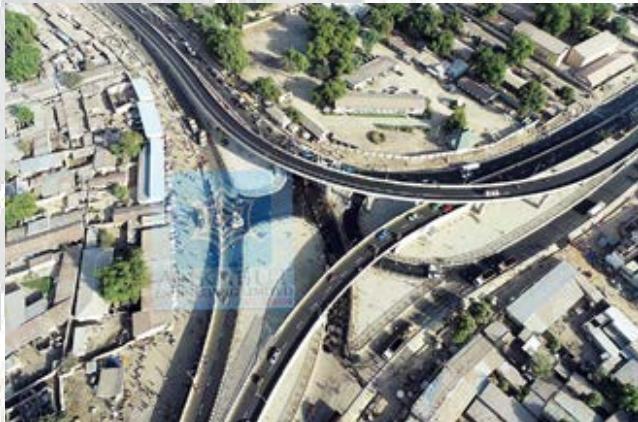
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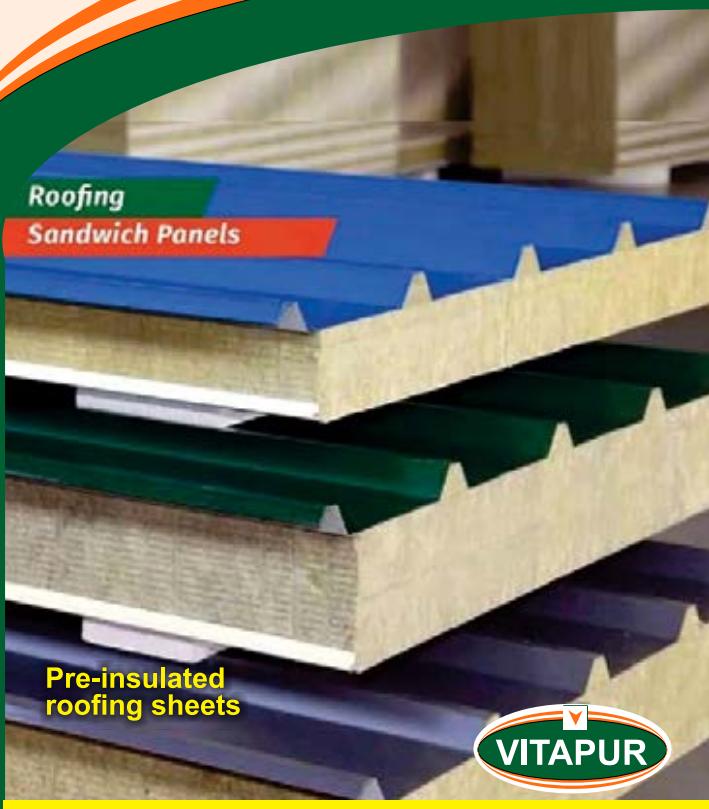
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FROM THE EDITORIAL SUITE

Ticking of the clock is ongoing and it has brought us to the unique season of presenting the 1st edition of “The Consulting Engineer” magazine in 2024. It comes with the theme, “Development of Civil Infrastructure”. The buzzword, ‘Infrastructure’, is wide and entails civil, electrical, mechanical, health service, oil & gas structures, among others. This edition focuses more on civil infrastructure. As usual, we are delivering value to the teeming readers with the vision of

having in print a repertoire of salient information for the current and future generation.

The first article is entitled “Management of Environmental, Social & Governance Risks in Infrastructure Development Projects” by Engr. Jones Nwadike, FNSE, FNIHTE, FNICE(CEO, Japavisca Engineering Company Limited). He has treated the subject in a comprehensive manner covering the essential areas worth noted in execution of projects. ESG risks are real and should not be ignored. Other articles in this edition are:

1. Outlook on Highway Infrastructure Roadmap & Implementation in Nigeria by Engr. Ebere Izunobi, FNSE (Deputy Director, Highways Planning, FMW)
2. The Role of Geotechnics in Curbing Failure of Structures by Engr. Mudashir Shittu, FNICE, MNSE, MNIGE (MD/CEO, Sitech Engineering Limited) & Engr. Ayotope Daramola, FNICE, MNSE (Civil/Geotechnical Engineer, Sitech Engineering Limited, Kaduna.)
3. Execution of Railway Line Projects in Nigeria: Achieving Sustainability & Safety by Nexant Consulting Limited

The PERSONALITY for this edition is Engr. Dr. Ilesanmi Bankole, FNSE, FNIHTE, FIICA, MASCE(CEO, Sanol Engineering Consultants Ltd). He is an accomplished professional whose success lends credence to the positive impact of integrity and industriousness in engineering practice. Young engineers should emulate him.

In this edition, the firm, ANKABUT ENGINEERING



Engr. Ademola Adeboya, MNSE

LIMITED, headed by Engr. Kam-Selem Alhaji Bukar, FNSE, is featured in the special supplement section. He is an icon in engineering family. His professional competence and leadership qualities have contributed immensely to the soaring feat of his firm with manifestations of numerous executed projects.

The corporate social responsibility activities undertaken by the firm should serve as an eye-opener to other successful firms in Nigeria’s business

space. Also, it is our pleasure to inform our teeming readers that Engr. Kam-Selem Bukar added another feather to his cap with his elevation to the post of ACEN President with effect from January 1, 2024. He has placed an inspiring presidential message in this edition for the engineering community and the general public. The Editorial Board wishes him an outstanding success in his tenure.

ACEN events, in the period under review, include: Business Evening, 2023 AGM and investiture of ACEN’s new President. Memorable pictures are presented in this edition.

Engr. Jolayemi Oyinloye, MNSE, President of ACEN future leaders, has made a presentation in this edition. It is worth reading, so go for it. Engr. E. E. Ubom, in his TIT-BITS column, presents some exciting information on magnificent infrastructure. Just know that man is creative and that magnificent structures are manifestations of the innate creativity of man.

Let us at this point congratulate Engr. Mrs. Olufunilayo Kadri, FNSE, FNIEEE, MNIEnvE, the new ACEN Managing Director, who assumed duties in February 2024. She took over from Engr. Kalejeiye Sunday, MNSE. The drive to fulfil the aspirations of ACEN rests on her shoulders and we wish her success.

Finally, we extend our deep appreciation to all those who contributed to the successful publication of this edition

Engr. Ademola Adeboya, MNSE
(Chairman, Editorial Board)

ACEN PRESIDENT'S ADDRESS ON DEVELOPMENT OF INFRASTRUCTURE

Dear Members and Stakeholders,

I am honored to address you as the President of the Association for Consulting Engineering in Nigeria (ACEN) on the crucial topic of infrastructure development. As we navigate the challenges and opportunities in this field, it is imperative that we recognize the pivotal role that consulting engineers play in shaping the future of our nation.

Infrastructure development is the backbone of any thriving economy. It encompasses a wide range of sectors, including transportation, energy, water supply, telecommunications and urban development. The quality and efficiency of our infrastructure directly impact the well-being and prosperity of our citizens.

Nigeria, as a rapidly growing nation, is in dire need of robust and sustainable infrastructure. It is our responsibility as consulting engineers to ensure that the projects we undertake are not only technically sound but also socially and environmentally responsible. We must strive for excellence in every aspect of our work, from planning and design to execution and maintenance. ACEN, as the leading professional association in consulting engineering, is committed to promoting best practices and fostering innovation in infrastructure development. We will continue to collaborate with government agencies, private

sector stakeholders and international partners to create an enabling environment for the successful implementation of infrastructure projects.

One of our key priorities is the Development of Infrastructure.

Dear Esteemed Members,



**Engr. Kam-Selem Alhaji
Bukar, FNSE, FNICE, FNIHTE,
PE, M.ASCE (ACEN President)**

Colleagues and Partners, As the President of the Association for Consulting Engineering in Nigeria (ACEN), I am privileged to address you on the pivotal subject of infrastructure development, a cornerstone for the progress and prosperity of our nation. Infrastructure is not merely a matter of convenience; it is a critical driver of economic growth and social development. In Nigeria, we are at a transformative stage where the need for robust, innovative and sustainable infrastructure has never been more pressing. Our roads, bridges, power plants, water systems, and digital networks are the arteries through which the lifeblood of our economy flows.

At ACEN, we understand that the task before us is monumental. The development of infrastructure is a multi-dimensional challenge that requires a confluence of technical expertise, strategic planning and collaborative effort. As consulting engineers, we are the vanguards of this endeavor, tasked with the design and implementation of infrastructure projects that are not only structurally sound but also economically viable and environmentally sustainable. Among many infrastructure projects in Nigeria executed by Nigerian engineering consulting firms, the project shown in Fig. 1 is one of such example.



Fig. 1: Newly completed Trumpet Flyover at Borno Express Terminus junction, Maiduguri, Borno State, Nigeria

Our vision for Nigeria is a future where infrastructure catalyzes inclusive growth, where every citizen has access to reliable services and where our cities and communities are interconnected by a network of efficient and resilient systems.

2024 ACEN Council



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THE ASSOCIATION FOR CONSULTING ENGINEERING IN NIGERIA (ACEN)

The Association for Consulting Engineering in Nigeria, ACEN, was founded in 1971 and registered in 1979. ACEN is a body of registered independent private engineering consultancy firms and the voice of the profession in Nigeria.

MISSION STATEMENT

"ACEN shall build a strong membership that fosters equal opportunities, creates competitive advantage through increased visibility with strategic partners, and improves the standards of consulting engineering in line with international best practice."

VISION STATEMENT

"To remain the ultimate reference business association of choice for organisations providing professional engineering consultancy services in Nigeria."

FUNDAMENTAL OBJECTIVES

- Ensure that the highest level of technical competence and business ethics are brought to bear on the practice of the profession in Nigeria.
- Ensure that every State has the highest level of Consulting Engineering practice by having members in every state of the federation and the federal capital.
- Increase the number of engineering firms in the country relative to the size of the nation.
- Ensure that stakeholders in the built environment get maximum value for their investments by monitoring standards of practice within the industry.
- Grow the industry by promoting the growth of large consulting engineering firms.

ACEN MEMBERSHIP

Prior to December 2007, ACEN membership was open to individual and firm members, who possessed the required experience and professional integrity. At the 2007 AGM, a motion was passed limiting ACEN membership to firms. This was to further emphasize the business nature and focus of the association. Membership is therefore now open to Consulting Engineering firms with the adequate experience and commitment to continuous improvement in technical and business integrity. Today, ACEN's member firms numbering about 300 are located in the 6 geo-political zones and the FCT.



ACEN & COREN

The Council for the Regulation of Engineering in Nigeria is the statutory body responsible for the regulation of all Engineering activities in Nigeria. It is empowered to keep a register of all Engineering craftsmen, technicians, technologists, Engineers and Consulting Engineering Firms who wish to practice in the country. No individual or organization is allowed to practice Engineering in Nigeria without the approval of COREN. Thus all member firms of ACEN must be registered with COREN and the members of such firms must also be individually registered by COREN. ACEN has just recently been mandated by COREN to register on its behalf all consulting engineering firms in the country. Furthermore, ACEN President now seats on the Council of COREN. Thus, ACEN is now better positioned within the built industry.



ACEN & NSE

The Nigerian Society of Engineers is the umbrella association of all graduate Engineers in Nigeria and all Engineers employed in ACEN member firms are members of NSE. Conversely, most members of NSE with an interest in Consulting Engineering practice are members of ACEN. ACEN focuses only on the business interest of Consulting Engineering Firms and her interest is, therefore, specific and complementary to the scope of COREN and NSE.



ACEN & FIDIC

The International Federation of Consulting Engineers is a 100-member organisation that provides the strongest platform for our international activities. FIDIC is the voice of Consulting Engineering all over the world, and this it does through seven major focus areas: Representation, Business Practice, Ethics/Integrity, Image, Sustainability, Globalization and Quality.

FIDIC is perhaps best known for its contract documents, which are used all over the world, especially for international projects in the third world. The documents are used extensively by the Nigerian Federal Ministry of Works. In addition, FIDIC has Manuals on a Guide to Practice that teaches best practice in Consulting Engineering, Business Integrity Management, and Quality Management amongst several others.

Two (2) ACEN members, Engr. J.I. Folayan and Engr. Bayo Adeola have served on the FIDIC Executive Committee, the highest level of the organization. Other ACEN members have served on committees and task forces of the organization, and members attend the yearly annual conferences in large numbers regularly.



ACEN & FIDIC Africa

FIDIC Africa is the FIDIC Group of African Member Associations which addresses specifically, African concerns. FIDIC Africa currently has 14 members, holds regular annual conferences and AGMs, and promotes networking among its members. Nigeria played a very active role in the formation of FIDIC Africa and has continued to be very active in the Association.

ACEN Past President, Engr. (Mrs.) Mayen Adetiba, was once Chairman of FIDIC Africa while several ACEN members have served on the Executive Committee including ACEN's past Presidents, Engr. Charles 'Yele Akindayomi and Engr. George C.

Okoroma (JP), who are members, presently, of the FIDIC Africa Executive Committee.

ACEN ACTIVITIES

ACEN provides a series of activities tailored to deliver service and benefits to our members in these key areas:

- Training through the ACEN School of Consulting Engineering.
- AGM & EGM for effective dissemination of information to members.
- Attending International Conferences.
- Membership / Certifying Standards.
- Advocacy.
- Quarterly Business Evening meetings to discuss topical issues affecting members.
- The Young Professionals Forum.
- Triannual publication of "The Consulting Engineer" magazine.
- Monitoring and follow-up on policies and bills relating to matters of engineering practice.
- Legal retainership program to advise members on legal issues.
- Advancing the practice of consulting engineering for favourable business environment for members.
- Setting up of Special Task Forces on: The collapse of buildings, conditions of engagement/ scale of consultancy remunerations, quackery, Industry study, formation of built industry transparency initiative, local content for the construction industry, etc.

CHALLENGES OF ACEN

Despite the fact that ACEN has been in existence for fifty-three (53) years, some of the challenges leading to its formation have remained while new ones have emerged. The most notable current challenges are as follows:

- Unfavourable Government procurement policies especially in the states.
- Private sector perception.
- Loss of Engineers to other sectors due to low remunerations.
- Number, size and scope of ACEN Member firms.
- Delayed payments to members.
- Limited awareness and knowledge of the savings consultants contribute to the overall cost of projects if employed by governments and entrepreneurs.
- Inadequate corporate sponsorship to enhance smooth operations of the organisation.

BRIEF PROFILE OF RECENTLY APPOINTED MANAGING DIRECTOR OF ACEN

Engr. Kadri holds a Bachelor of Science Degree in Electrical Engineering from Queen Mary University, London (1980) and has over forty-two (42) years of work experience as a seasoned Engineer.

She is a COREN Registered Engineer; a Fellow of the Nigerian Society of Engineers (FNSE); a Fellow of the Nigerian Institute of Electrical and Electronic Engineers (FNIEEE) and a Member of the Nigerian Institution of Environmental Engineers (MNIEE).

Engr. Kadri is on the governing council of the Nigerian Institute of Electrical and Electronic Engineers.

In addition, Engr. Kadri is an Accredited Cost Engineer (ACostE) of the Institute of Appraisers and Cost Engineers and also an Associate of the Chartered Institute of Arbitrators UK (ACIARB).

She is a Founding Member of Association of Professional Women Engineers of Nigeria (APWEN) where she served as National General Secretary (1992 - 1993) and Chairman, Business and Entrepreneurship Committee (2019-2021).



Engr. Mrs. Olufunmilayo Kadri, FNSE

INTERVIEW WITH ENGR. MRS. OLUFUNMILAYO KADRI, FNSE (MANAGING DIRECTOR, ACEN)

TCE MAGAZINE

You resumed as the new Managing Director of ACEN recently, precisely in February 2024. You must have been pondering over some innovative ideas to inject into ACEN's aspirations. Can you share these ideas with 'TCE Magazine'?

*“...networking event
for sharing engineering
development...in a relaxed
setting...”*

ENGR. KADRI: ACEN aspires to

- Strengthen Consulting Engineering practice in Nigeria
- Build strong membership that fosters equal opportunities
- Be the ultimate reference for providing professional engineering consultancy services in Nigeria.

ACEN member firms are actively built up and strengthened through trainings, workshops, ACEN Business Evenings (networking event for sharing engineering development and infrastructure talk in a relaxed setting), AGMs and EGMs. In addition,

"It is not a child's play to become an ACEN member firm - the process is rigorous and membership is renewed every 3 years by proving that the firm still qualifies to use the ACEN logo and the FIDIC logo on their communication materials."

international conferences at the continental and global level are significant learning events. Our members participate on committees of FIDIC at continental and global levels also.

These activities are valuable in developing global standards of excellence, thus strengthening ACEN member firms. Membership of ACEN also bestows on ACEN members the privilege of having ACEN and FIDIC brands on their communication material. It is not a child's play to become an ACEN member firm - the process is rigorous and membership is renewed every 3 years by proving that the firm still qualifies to use the ACEN logo and the FIDIC logo on their communication materials.

So back to your first question about what new ideas this new MD wishes to bring into ACEN. We need a louder campaign. ACEN already has in place a strategic approach which involves communication, advocacy and relationship-building. One of the areas which we will see changes is that ACEN will not be quiet. It is really good to know that the new ACEN President, Engr. Kam-Selem A. Bukar, FNSE and this new ACEN MD agree on this. ACEN will visit Government ministries, departments and agencies (MDAs) to establish mutually beneficial relationships; forge relationships with other professional organisations with whom we can collaborate for mutual benefit.

ACEN is adding, to its targeted awareness campaigns, informative campaign flyers, to educate government officials, entrepreneurs, and the public about the valuable contributions of consulting engineers to project cost-effectiveness and overall success and benefit of using the services of local consultants. Additionally, ACEN will collaborate with media outlets to feature success stories, case studies and interviews highlighting the impact of consulting engineers on project efficiency and cost savings.

ACEN has been in the news lately due to coverage of the 'Training and Specialised workshop for World Bank'. It was on NTA network news and in various newspapers, both print and online. We should expect to be seeing and hearing esteemed ACEN members, like our past presidents and Exco members, expressing ACEN's views in professional discussions on various media including television and social media platforms.

ACEN will also strengthen its online presence by making our website more user-friendly and our social media platforms evenmore interesting. We intend to provide informative content to reach a broader audience. The more ACEN is known, the more our perceived relevance will approach our professional importance. They say, 'Perception is everything'. This, of course, is not entirely true! However, if you do not display your goods, nobody will see them, not to talk of buying them.

We shall be showcasing our success stories of projects, initiatives and case studies undertaken by ACEN and its members firms.

TCE MAGAZINE

What do you think are the strategies ACEN can adopt to effectively align with the future of Nigerian (Local) Content in infrastructural development activities of the three tiers of Government in Nigeria?

The Nigerian Content Act defines Nigerian content in Section 106 as "the quantum of composite value added to or created in Nigeria through the utilization of Nigerian resources and services in the petroleum industry resulting in the development of indigenous capability without compromising quality, health, safety and environmental standards".

Executive Order 5 seeks the development of local capacity in Nigeria's engineering sector through

increased Nigerian content in public procurement. In order to achieve this, it mandates all ministries, departments and agencies (“MDAs”) of the Federal Government to give preference to Nigerian companies and firms during procurement. It also mandates that Nigerian companies or firms (companies with at least 51% control vested in Nigerians) shall be the lead in any consultancy involving joint venture relationships and agreements relating to the professions, including Engineering.

ACEN member firms must leverage on the reality that they have everything and step up to the plate. One important step is to form a consortium – pool knowledge and resources to be able to compete with international firms. In addition, they are to leverage on the advantage of their local presence so as to shore up the naira. While also making much of their global excellence, ACEN consulting firms integrate local insights with global best practices and it is this aspect that must be leveraged on. Their deep understanding of Nigeria’s socio-economic, cultural and environmental dynamics engenders skillful blending for better outcomes. This fusion of local and global knowledge fits them to develop tailored solutions that are both culturally sensitive and internationally competitive.

“Another area which I hope that we will be able to address, while I am MD, is the limited awareness regarding the considerable cost savings and contribution to successful outcomes which Professional Engineering Consultants contribute to engineering projects (particularly infrastructural).”

In the book, *Engineering is Development* written by ACEN Past President, Engr. Bayo Adeola, it has been clearly demonstrated that this quality is to be preferred for providing infrastructural projects for developing nations and Nigeria is one.

TCE MAGAZINE

Delay in payments for consultancy services rendered by ACEN member firms has become a nagging problem. How best can this problem be solved to keep ACEN member firms from folding up and by extension keep ACEN alive as a relevant and significant professional association in Nigeria?

ENGR. KADRI: Another area which I hope that we will be able to address, while I am MD, is the limited awareness regarding the considerable cost savings and contribution to successful outcomes which Professional Engineering Consultants contribute to engineering projects (particularly infrastructural). There is this saying which goes like this, ‘If you do not value something, you will abuse it’.

That is the case of procurers of consulting engineering services in Nigeria. They do not know that when they employ a competent consulting engineering firm, they are doing themselves a great favour. They

need to realise what the Nigerian consultants save them in time and money by significantly reducing both the initial and lifecycle costs of the infrastructure/facility. This realization will make them to be more open in ensuring that they do not kill the duck that lays the golden eggs.

So, again, the answer is enhanced and unrelenting advocacy campaigns. We must, also, set up mechanisms for consequences to shake non-payers.

TCE MAGAZINE

Thank you for your time. We pray your dreams for ACEN be fulfilled for the benefit of ACEN and Nigeria.

ENGR. KADRI: Thank you.

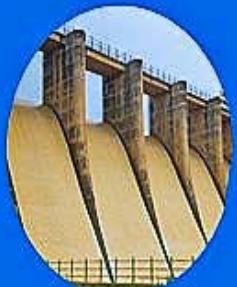


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MANAGEMENT OF ESG RISKS IN INFRASTRUCTURE DEVELOPMENT PROJECTS

BY ENGR. JONES NWADIKE

ABSTRACT

This paper presents the findings of a study of the factors in environmental, social and governance (ESG) risk management that are currently inhibiting the achievement of infrastructure development project objectives. Every consulting firm faces a variety of ESG-related issues and some of them have the potential to be material and cause financial or reputational damage. Moreover, any consulting firm that neglects ESG issues is at increased risk of experiencing an ESG-related incident or controversy. Finally, the paper concludes that it is important for consulting firms to understand the nature of these risks, identify them, quantify them and thereafter manage and mitigate them in favour of infrastructure development objectives.

Keywords: Management, environmental, social, governance, risk, infrastructure, project, opportunities.

1.0 INTRODUCTION

Environmental, social and governance risk is a regular business risk. ESG risk management should be part of a consulting firm's standard risk reduction practice. The vision should be to have an integrated and inclusive ESG risk management focus by consultants that will improve the quality of life, strengthen the economy through effective and efficient infrastructure development.

2.0 STATEMENT OF THE PROBLEMS

The following are some of the ESG factors identified and assessed as possible current bottle-necks or inhibitors bedeviling institutional arrangements regarding management of ESG risks in infrastructure development projects:

- i. Use of unqualified consultants
- ii. Inadequate power supply
- iii. Bad government policies
- iv. Weak and unsuitable institutions
- v. Insufficient capital
- vi. High degree of foreign dependence
- vii. Low purchasing power of the populace
- viii. Competition with foreign goods
- ix. Shortage of raw materials for production
- x. Shortage of entrepreneurs
- xi. Political instability
- xii. Inadequate transportation and communication facilities
- xiii. Inadequate skilled man-power, etc.

3.0 AIMS AND OBJECTIVES OF THE STUDY

This study focuses on ESG risk management meant to enhance socio-economic development and promote sustainable poverty reduction achievable by strengthening ESG and participatory planning. The aim is also to ensure sustainable use of renewable natural resources in the construction of social infrastructure.

4.0 SIGNIFICANCE / JUSTIFICATION OF THE STUDY

The study brings to the fore the immense contribution of infrastructure development projects towards stimulating productivity and other socio-economic activities. The study is justified because consulting engineering professionals are unarguably very relevant in infrastructure development projects planning and execution by virtue of their training and experience. Their roles will also be brought to the fore.

5.0 SCOPE AND LIMITATION OF THE STUDY

The scope of the study is limited to infrastructure development projects.

"Environmental, social and governance risk is a regular business risk."

	1st	2nd	3rd	4th	5th
0 - 2 years Short-term risks	Infectious diseases	Livelihood crises	Extreme weather	Cybersecurity measures	Digital inequality
3 - 5 years Medium-term risks	Asset bubble burst	IT infrastructure breakdown	Price instability	Commodity shocks	Debt crisis
5 - 10 years Long-term risks	Weapons of mass destruction	State collapse	Biodiversity loss	Adverse tech advances	Natural resource crises

Economic	Geopolitical	Environmental	Technological	Social
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Table 1: Economic, geopolitical, environmental, technological & social risk matrix. Source: World Economic Forum Global Risks Report 2021.

6.0 RESEARCH METHODOLOGY AND ORGANIZATION OF THE STUDY

The empirical method of research was used covering field work and specific method of articulation. The study adopts exploratory method of research on issues of interest in the management of ESG risks in infrastructure development projects to achieve socio-economic development objectives. Sources of information for the study include library books, previous works by the author, detailed investigations done on infrastructure procurement by the author, internet and articles from learned journals. The organization of the study covers key aspects of the subject being considered.

6.1 DEFINITION

'Environmental, social and governance' (ESG) refers to a collection of corporate performance evaluation criteria that assess the robustness of a company's governance mechanism and its ability to effectively manage its environmental and social impacts. Broadly, the term 'ESG' refers to the examination of a company's environmental, social and governance practices their impact and the company's progress against benchmarks.

i. **Environmental aspects:** These aspects include how a business performs as a steward of our natural environment broken down into biodiversity, habitat, climate change, land contamination, energy consumption, greenhouse gas emissions, indoor environmental quality, location and transportation, materials, pollution, resilience to catastrophe / disaster, renewable energy, sustainable procurement, waste management, water consumption and deforestation.

ii. **Social aspects:** Social aspects consider how a company treats people broken down into

community development, health & safety, human rights, inclusiveness and diversity, labour standards & working conditions, social enterprise partnering, stakeholder relations, occupier amenities (showers, changing rooms), controversial tenant issues, inequality issues, employee relationship and working conditions.

iii. **Governance:** Governance addresses how a corporation governs and polices itself. It includes anti-bribery & money laundering, cyber-security, data protection & privacy, legal & regulatory fines, ESG clauses in existing leases, executive remuneration, board diversity & structure, donations & political lobbying, policies and standards.

6.2 RISK

Risk refers to the chance of some unfavorable event occurring which in the context of the organization arises from a decision or a commitment and result in uncertainty and exposure, (Morrow D. et al, 2017 and Goulet J., 2017). Uncertainty is one of the few truly reliable forces in the world. Indeed, the world is risky. The only certain thing we can say about the future is... it is uncertain. No longer can risk be boxed into one category such as financial, digital or environmental (See Table 1).

6.3 INFRASTRUCTURE

Infrastructure consists of the basic facilities, services & installations needed for the functioning of a community or society such as electric power, transportation, water & sanitation, health, education, oil and gas, housing, tourism, emergency response, security and law, etc. Infrastructure stock ranks E2 2.08 as poor state out of 5.00 which world class. Poor state rank constitutes a danger to public safety (Source: Nigeria Infrastructure Report Card, 2014).

7.0 THE EMERGENCE OF ESG

Clearly, one of the major risks organizations face today is related to the environment. In 2019, the World Economic Forum's Risk Report listed weather events, climate change and natural disasters as the top risks by likelihood and impact. That has not changed. However, several other risks have surfaced based on the extraordinary events of these last two years.

Social factors have become front and center issues in many discussions. Economic disparities, the effects of COVID-19 pandemic and a host of other events have led to an awakening – highlighting the responsibility of companies to understand and respond to social shifts. Behind this responsibility lies the capability within organizations to govern the business with methods that create agility to alter any course due to market shifts, but also apply discipline to address environmental and social concerns. These concepts are also not new. Corporate social responsibility (CSR) has been on the table for several years. This new world, however, has beamed a spotlight on these issues leading to the emergence of ESG.

8.0 RISK AND OPPORTUNITY MANAGEMENT

Managing risks and opportunities is, in many ways, separate from the daily toils of business and therefore necessitates an explicit effort to step back and see the full risk and opportunity picture. Managing risk and opportunity is a continuum as illustrated in Fig. 1. The practice is increasingly related to

strategy, operating performance and shareholder value enhancement, in addition to compliance and prevention.

9.0 THE ROLE OF CONSULTING ENGINEERING PROFESSIONALS

The role of consulting engineering professionals in capturing, analyzing and managing opportunities related to risk cannot be overstated. Consultants are increasingly applying these non-financial factors as part of their analytic process to identify material risks and growth opportunities. Incorporating and reporting on ESG can help companies realize the huge potential of ESG within and beyond the organization.

Management of these issues is heavily grounded in the role of consulting and contracting professionals because of their contribution to:

- Designing, implementing and overseeing the technical aspects of the infrastructure development process
- Informing the Board of Directors of this process and its outcome. Consulting professionals can develop approaches to identify and measure opportunities and risks. Six essential ways to carry this out are as follows:
 - Establishing guidelines and procedures for strategic planning around opportunities and risks
 - Improving the identification, measurement and management of risks and opportunities
 - Preparing the evaluation
 - Integrating the model



Fig. 1: Risk & Opportunity Management Continuum

*"In 2019,
the World
Economic
Forum's Risk
Report listed
weather
events,
climate
change..."*

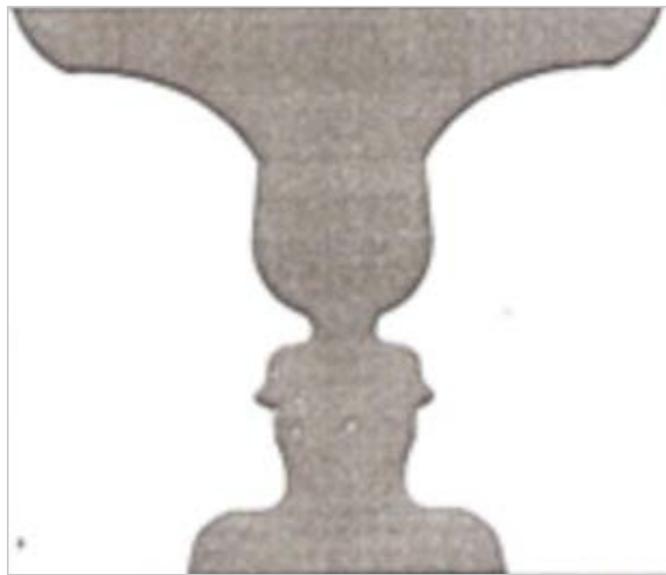
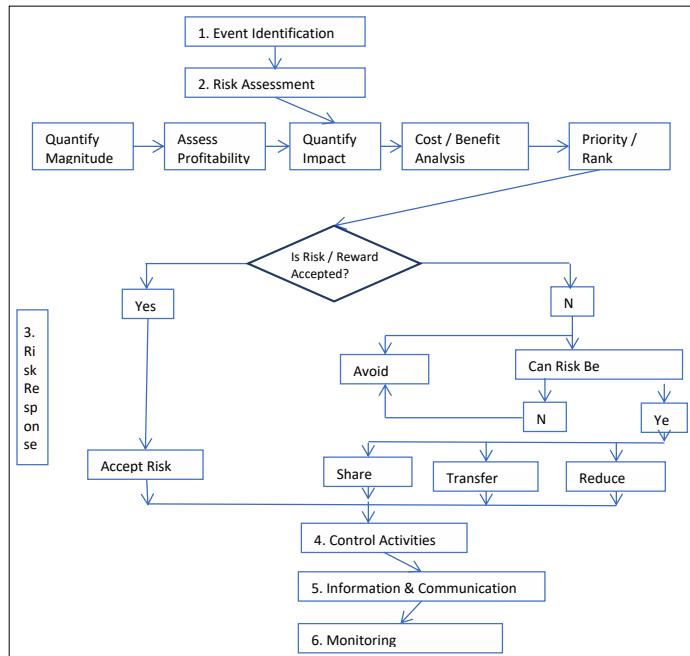


Fig. 3: A vase and two faces

Fig. 2: Risk management process

There is a six-step risk assessment model illustrated in Fig. 2. The model includes event Identification, risk assessment, risk response, control of activities, dissemination of information & appropriate communication and monitoring.

The model should have established policies, procedures and information mechanisms that allow for innovation to thrive within and across organizations. Some of these are summarized in Table 2.

Risk Type	Risk	Opportunity	Example
Social Risk	Obesity litigation	Develop new products for healthier eating	Company's innovates to provide sliced apples, treated with natural product to ensure freshness, in Happy Meals. Creates more appealing salads and partners with Company's own to provide high quality salad dressing.
Human Resources Risk	Aging workforce	Develop creative solutions to retaining retirement-age workers in more flexible positions.	Large company devises a "Retirement Reservist Pool" to allow an aging workforce to transition into retirement over time and still provide expertise to the company on a part-time basis, thus retaining institutional memory
Innovation Risk	Demand for core product diminishes	Project 10-20 years into the future and think about where the industry is headed; compete in advance.	Another Company develops Prius hybrid gas-electric car years before competition. Another company develops a variety of energy efficient appliances including water-saving washing machines and high efficiency light bulbs.
Business Continuity Risk	Market gets saturated	Ensure ongoing and increasing consumption in existing markets, if cannot expand to other markets.	A company lobbies for increased Federal Minimum Wage to boost disposable income of rural Nigerians, its core market, and ensure continued success.

Table 2: Examples of risk and their potential opportunities

Being able to see risks and opportunities simultaneously is similar to perceiving both the vase and the two faces in the optical game in Fig. 3.

The capacity to see both the faces and the vase or risks and opportunities allows companies to develop flexible organizations that can manage value protection and value creation simultaneously.

10.0 RISK & OPPORTUNITY MANAGEMENT PROCESS

Consulting firms that are successfully exploiting and protecting present opportunities and exploring future innovations while managing risk are called "ambidextrous organizations". These consulting organizations are able to attend to the products and processes of past successes while capturing the opportunities that will define the future. Creating an ambidextrous organization requires a system to identify, manage, measure, evaluate and monitor both risks and opportunities within the existing management structure.

"With the seemingly endless stories of natural and man-made disasters, risk has increasingly been... negative..."

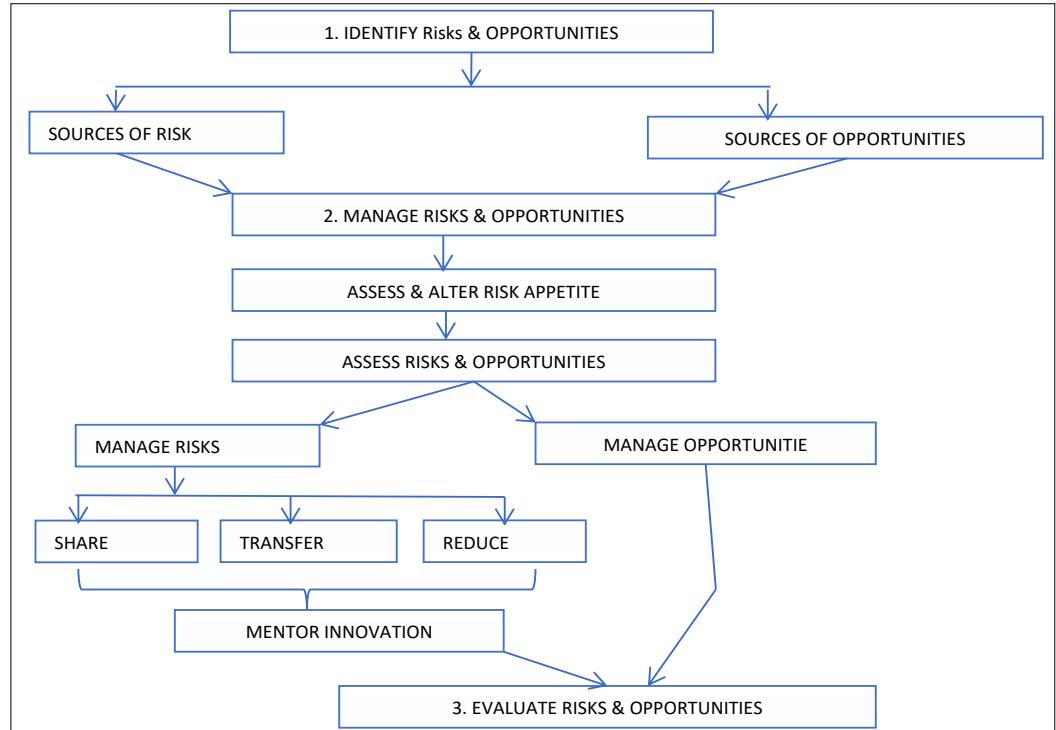


Fig. 4: Risk and opportunity management process.

Fig. 4 depicts the process of risk and opportunity management. It builds on and modifies the Risk Management Process Model in the 2005 Management Consulting Guideline entitled, "Identifying, Measuring and Managing Organizational Risks for Improved Performance". Fig. 4 includes opportunities and additional tools and techniques to foster and manage innovation within the risk management context for improved decision making.

11.0 IDENTIFYING RISKS & OPPORTUNITIES

With the seemingly endless stories of natural and man-made disasters, risk has increasingly been considered a negative phenomenon that must be managed. Although true, it is just one side of a two-sided coin. In fact, consulting companies prosper by taking risks and lose money by failing to manage them. There is therefore, need to be able to identify sources of risk and opportunities and move further to management.

11.1 SOURCES OF RISK

Sources of risks are often placed in four categories, namely strategic, operational, reporting and compliance (See Fig. 5).

Strategic risks relate to a firm or organization's choice of strategies to achieve its objectives. Operational risks relate to threats from ineffective or inefficient business processes for acquiring, financing, transforming or marketing goods and services as

well as threats of loss of the firm's assets including its reputation. Reporting risks relate to the reliability, accuracy and timeliness of information systems and to reliability or completeness of information for use in either internal or external decision making.

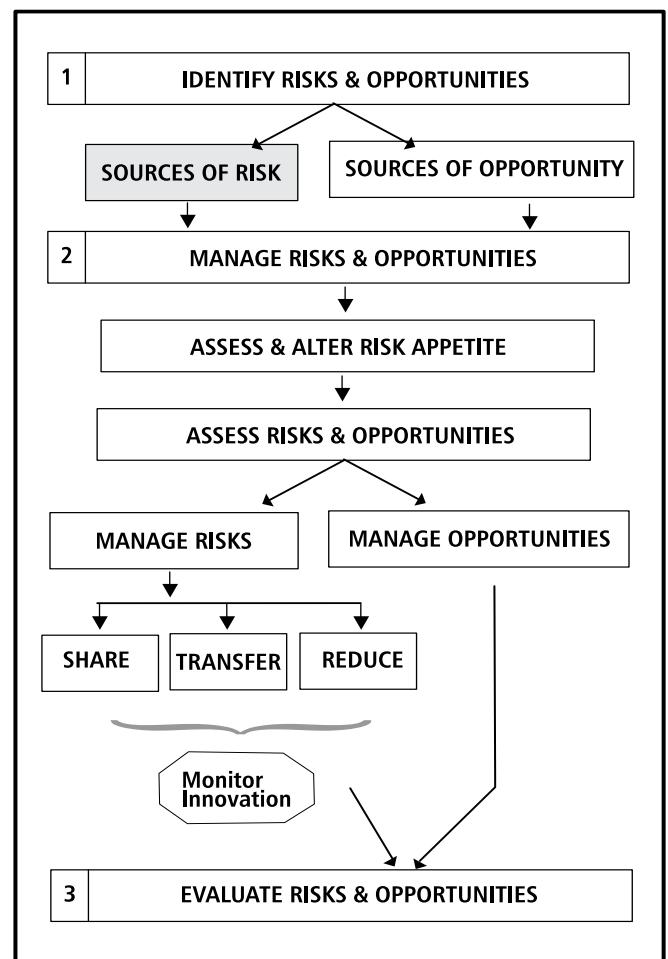


Fig. 5: Sources of risks

Compliance risks address the presence or lack of systems to monitor communication of laws and regulations, internal behavior codes and contract requirements. Compliance risks also address the provision of information about failure of management, employees or trading partners in relation to applicable laws, regulations, contracts and expected behaviors.

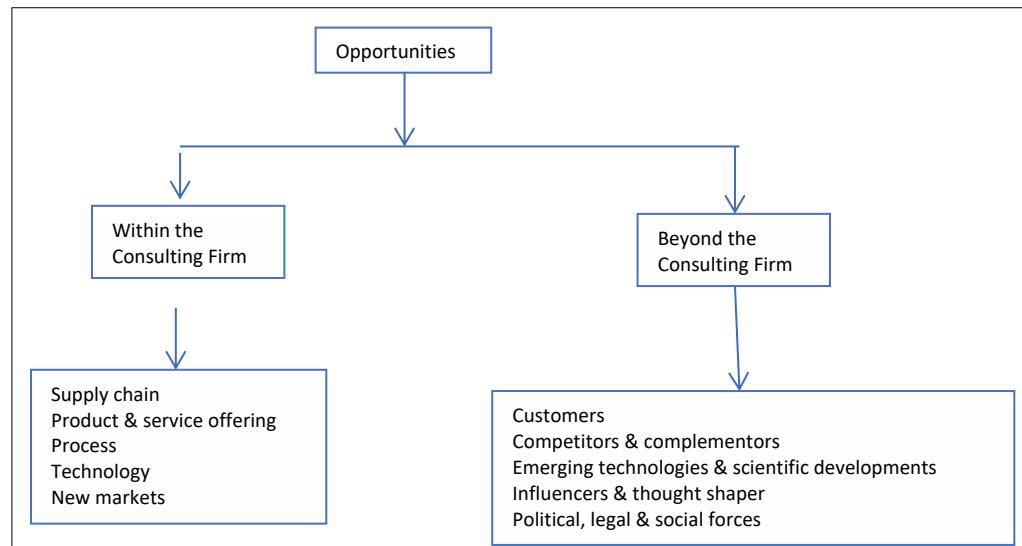


Fig. 6: Sources of opportunity.

Fig. 5 illustrates this risk classification scheme and lists some of the issues that fall within each category. Each of strategic, operational, reporting and compliance risks has a number of subcategories. Consulting firms should establish their own lists of risks that are most relevant to their businesses and business environment.

11.2 SOURCES OF OPPORTUNITY

In addition to identifying threats to the organization, it is also critical to identify opportunities. Opportunities can emerge not only from within the organization, but also from outside the narrow focus of day-to-day business. Fig. 6 illustrates some potential sources of opportunity.

This list is not exhaustive. It represents a selection of potential sources from which to identify opportunities which can prompt innovation.

11.3 ASSESSING AND ALTERING RISK APPETITE

Risk appetite is generally defined as the amount of risk exposure or potential adverse impact from an event that an organization is willing to accept without taking action. Once the risk appetite threshold (also termed the risk tolerance) has been reached, measures can be taken to bring the exposure level back within the accepted range, thus matching risk exposure with risk appetite. Risk appetite can also be described as intelligent risk taking, coupled with disciplined risk management (See Fig. 7). A variety of factors influences an organization's level of risk appetite and its ability to accept more risk.

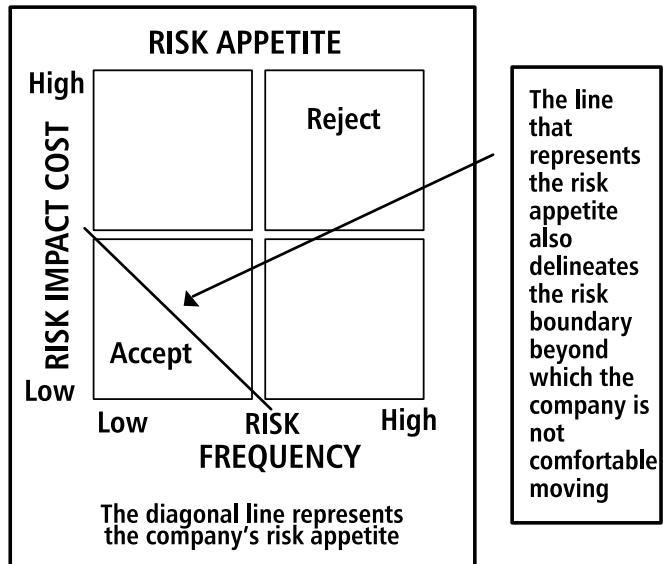


Fig. 7: Organizational risk appetite.

These include:

- Willingness to bet
- Organizational size
- Financial health
- Reputation
- Superior tools
- Experience
- Agility

11.3.1 Altering Risk Appetite

Although the board sets the overall risk philosophy, sometimes strict adherence to the philosophy may prevent organizations from capitalizing on identified prospects. Flexibility allows the organization to develop the capacity to accept more risk, thereby shifting the risk appetite boundary as depicted in

“...identifying threats to the organization, it is also critical to...”

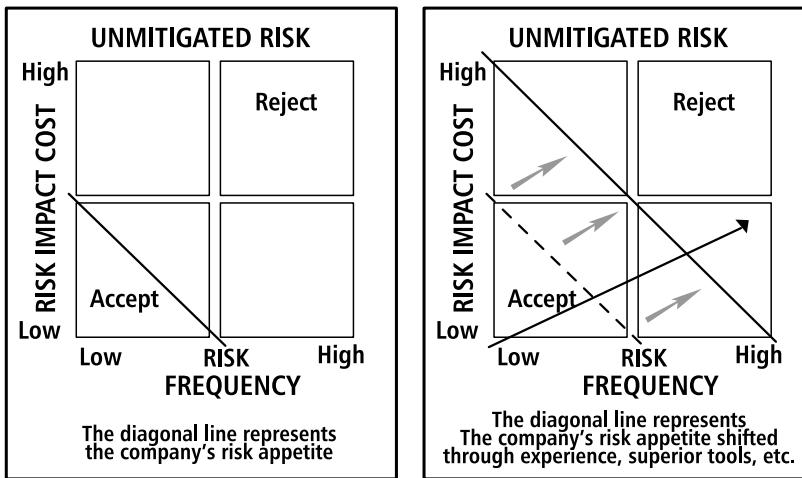


Fig. 8: Risk appetite tolerance.

Fig. 8. Organizations can alter their risk appetite in a variety of ways. Some of these include:

Through experience by: -

- Improving organizational learning
- Using networks for increased learning

Through superior tools, including:

- Expanding the time horizon
- Expanding the breadth of stakeholders considered in the analysis.

11.3.2 Assessing Opportunities

Traditional methods can be applied when assessing the potential benefits of opportunities. These assessment methods include:

- 1) Assessing the increased market share that can be captured
- 2) Calculating the likely profit from the innovation
- 3) Quantifying the number of new customers
- 4) Calculating the potential sales growth that could stem from capturing the opportunity

11.3.3 Assessing Risks

Measuring risk can be done in three steps:

- i. Quantify the magnitude of the impact of the risk
- ii. Assess the probability that the risk will emerge and affect the company
- iii. Quantify this impact on the company. Use: (Magnitude) x (Probability)

11.3.4 Managing Risks

So, instead of increasing risk appetite (moving the risk appetite line out in Fig. 8, mitigation strategies lower the level of risk and move the project within an acceptable range, as illustrated in Fig. 9. Some of the techniques to move the project within an acceptable risk range include traditional risk

mitigation strategies such as sharing, transferring and reducing risk as well as less conventional ones such as becoming more agile, double betting, and viewing risk through a different lens.

12.0 A BLUE-PRINT FOR THE FUTURE

In September 2021, ISO published ISO 37000 (Governance of Consulting organizations). Developed by international experts over a four-year period, the guidance draws on all the principal international corporate

governance codes and standards. Input was received from multiple international professional bodies including the World Federation of Engineering Organization (WFEO), International Federation of Consulting Engineers (FIDIC), The International Corporate Governance Network (ICGN), The World Business Counsel for Sustainable Development (WBCSD) and many others.

12.1 MATERIALITY MAPPING

'What Matters Most' is common language for 'What's Material' to consultants and investors, as they make decisions, as whether to invest or exit. For example, companies which are heavy greenhouse gas (GHG) emitters adversely affecting the environment are unlikely to attract investor interest, if they do not have a credible ESG story explaining their approach to long term viability.

12.2 TRACKING AND TRACING

A practical and effective way to think of ESG is to think of it as all the non-consulting activities required to be undertaken in pursuit of a consulting financial return.

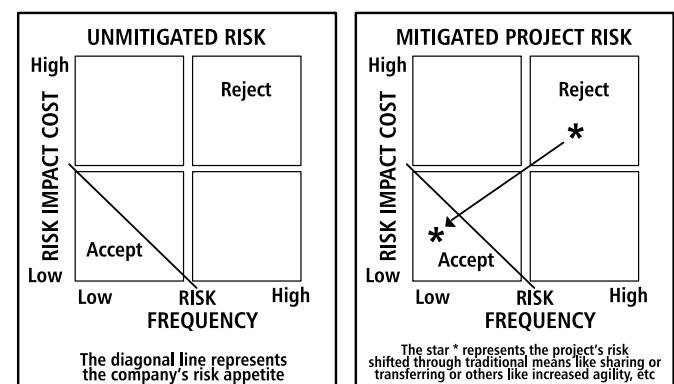


Fig. 9: Alerting project risk.

An example of ESG topic for one consulting firm or industry sector is given in Table 3.

12.3 ESG REPORTING

Reporting across the various ESG frameworks and standards follows a common pattern of telling the story of the application of internationally-proven and accepted risk methods and practices to business. Furthermore, the rise in ESG investing reflects ESG status as a virtual gateway to risk capital as good ESG data is equally becoming a proxy for good ESG risk governance. Primarily, consultants

need to know what actions are in place to meet the needs of the constituents, namely consultants, investors, regulators and customers in rendering ESG services. This should be part of the report.

13.0 RECOMMENDATIONS

A number of key messages emerge from the study. These need to be kept in mind when proposing changes to management of ESG in infrastructure development projects in order to enhance the delivery of ESG development objectives.

- i. The whole life cycle of the ESG risk management should be considered during planning, design and an operation and maintenance strategy developed for each new infrastructure development project.
- ii. It is clear that there are many stages in the ESG risk management cycle that are constrained by decisions taken earlier.
- iii. It is equally clear that there is little point in including obligations in management of ESG risk in infrastructure development projects

“Reporting across the various ESG frameworks and standards follows a common pattern of telling the story of the application of internationally-proven and accepted risk...”

ENVIRONMENTAL	SOCIAL	GOVERNANCE
Biodiversity and habitat	Community development	Anti-bribery and money laundering
Climate change	Health and safety	Cybersecurity
Land contamination	Human rights	Data protection and privacy
Energy consumption	Inclusion and diversity	Legal and regulatory fines
Greenhouse gas emissions	Labour standards and working conditions	ESG clauses in existing leases
Indoor environmental quality	Social enterprise partnering	Executive remuneration
Location and transportation	Stakeholder relations	Board Diversity and Structure
Materials	Occupier amenities - showers, changing rooms	Donations and political lobbying
Pollution	Controversial tenants	Policies and standards
Resilience to catastrophe/disaster	Inequalities	
Renewable energy	Employee relationship	
Sustainable procurement	Working conditions	
Waste management		
Water consumption		
Deforestation		

Table 3: Typical principles for responsible investing. Source The UN Principles for Responsible Investing for Real Estate.

that require certain actions on the part of the consultant, unless the actions have already been considered at the design and planning stage and budgets drawn up accordingly. Some method has also to be agreed for monitoring and enforcing compliance.

- iv. All stages of the ESG risk management cycle in infrastructure development projects must be managed with integrity as the watchword.

14.0 CONCLUSION

Consideration of operation and maintenance at the design stage of infrastructure development projects can stimulate enhanced ‘local content’ (of materials, labor and business). For a consultant who understands that ESG factors are inextricably linked to company performance over the long-term, enhancing ESG performance can lead to better results for business, people and planet.

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OUTLOOK ON HIGHWAY INFRASTRUCTURE ROADMAP & IMPLEMENTATION IN NIGERIA

BY ENGR. EBERE IZUNOBI

1.0 INTRODUCTION

A road (highway) is a path constructed to facilitate the movement of men and materials from one place to another. It plays an intrinsic role in the functioning of any society because of its significant relevance to economic activities. The Organization for Economic Co-operation and Development (OECD) defines a road as a line of communication (travelled way) using a stabilized base different from rails or air strips, open to public traffic, primarily for the use of road motor vehicles running on their own wheels. The first road ever built by mankind dates back to 4000 BC and since then road construction methods and funding have undergone phenomenal changes. Highway development in Nigeria dates back to 1925 when the Road Board was established by the colonial administration. The Board was charged with the responsibility of developing a blueprint for the trunk road network connecting major administrative centres during the colonial rule. The roads were further developed to move raw materials from the hinterland to the sea ports for export.

The provision of quality highway infrastructure in Nigeria becomes cogent, considering that an average of 50 people die every day by road accidents, according to a publication by Adewumi R. (2008). In 1914, the total road network in Nigeria was 3,200 km in length, 66,000km by 1960 and now the entire road network in the country is about 200,000km including Federal, State and local roads, of which only just about 50,000km are paved. The Nigerian Inland Waterways and Railways have not lived up to expectation, hence the predominant reliance of the nation's economy on road transportation. Only 80% of federal roads in Nigeria are partially paved, disallowing proper coverage of the nation's approximate 900,000km² landmass.

Nigeria, is one of the most populous countries in Africa and a good road network is critical to enable the country take advantage of the huge population for improved productivity and competitiveness.



*Engr. Ebere
Izunobi, FNSE (Deputy
Director, Highways
Planning, FMW)*

The government recognizes this, knowing that a well-connected road network will facilitate economic growth, improve transportation and enhance overall development in the country. This underpins the importance given to the road sector in various government policies. However, more political will and support from key actors in the sector are required to give the needed impetus towards transforming the sector.

2.0 HIGHWAY INFRASTRUCTURE ROADMAP (/POLICY)

Nigeria's Highway infrastructure Roadmap is embedded in the country's national development plans. Nigerian Development Plans include economic forecasts, policies towards the private sector and a list of proposed public expenditures. It is a medium-term blueprint designed to unlock the country's potentials in all sectors of the economy for a sustainable, holistic and inclusive national development. Other national documents that contain highway infrastructure development plan include the National Integrated Infrastructure Master Plan (NIIMP), Vision 20-2020 and the ECONOMIC RECOVERY & GROWTH PLAN 2017-2020 (ERGP).

During the first National Development Plan spanning 1962 to 1968, a total of N150.6 million was allocated to road development. The votes for the road sub-sector were in the range of 7% in the then Western Region to 25% in the Northern Region and a

"A road (highway) is a path constructed to facilitate the movement of men and materials from one place to another."

“...national development plan, the total projected investment was N2.05 billion while...”

national average of 11% for all projected investments. In keeping with the objective of rational allocation of scarce resources, the federal allocation of N70.8 million was meant to provide for only essential road development program which had been enveloped on the basis of a system of priority rating. In the first national development plan, emphasis was placed on the development of the: widening, straightening and surfacing of Trunk 'A' roads, construction of new Niger bridge from Onitsha to Asaba and Construction of a second Mainland bridge in Lagos.

Under the second national development plan, the total projected investment was N2.05 billion while the total allocation to transport was N485.189 million. The focus of road development under this plan was the rehabilitation of the roads that were adversely affected by the civil war.

The third national development plan had the total public investment figure of N32,855.016 billion. The allocation to road transport was N5,430.436 billion while allocation to roads as percentage of transport sector was 73.12%. Roads' investment as a percentage of all public investments was 16.25%. A total of N7.303.068 million was allocated to the transport sector out of the total of N32,855.016 billion for total investment.

The current National Development Plan (NDP) 2021-2025 prioritised funding for road construction and rehabilitation across the country. This includes sustaining on-going Federal Road projects with priority on routes 1 – 7 (major routes traversing North-South of Nigeria), ensuring high-traffic volume routes, geographical spread and the principle of additionality for urgent intervention requests outside the planned program. The document noted that the Federal Ministry of Works and Housing has adopted a public-private-partnership (PPP) methodology to enable private partners tap into the numerous commercial opportunities along the 35,000 km of Federal Roads Network under the ongoing Highway Development Maintenance Initiative (HDMI).

The revised NIIMP provides an integrated view of infrastructure development in Nigeria with clear linkages across key sectors. It identifies and elaborates on enablers for successful implementation in line with the current economic realities. It takes stock of existing infrastructure and identifies the required investments to bring infrastructure to the level desired by Nigerians in line with the country's growth aspirations. The document also specifically sets out the goal of raising Nigeria's infrastructure stock to at least 70.0 per cent by the year 2043.

The ERGP emphasizes the investment in infrastructure which includes highways. It highlights the priority of completion of ongoing projects and identifies new ones to be implemented in order to improve the national infrastructure backbone. Given the huge capital layout required to address the massive road infrastructure deficit in the country, the private sector is expected to play a key role in providing such infrastructure, either directly or in collaboration with government under public-private partnership (PPP) arrangements. The ERGP document further recommends the conclusion of the road sector reforms to establish a Road Authority and a Road Fund to enhance best world practice in the administration of road network development and management in the country. The document postulated the restoration of degraded sections of the Federal highway network to improve connectivity over a distance of 4,000 km

The Economic Recovery and Growth Plan (ERGP) serves as a framework for driving infrastructural development including the improvement of highways in Nigeria. Through strategic investments, rehabilitation and embracing innovative technologies, significant progress has been made in improving connectivity, boosting economic growth and enhancing road safety and security. However, challenges related to funding and sustainability need to be addressed to maintain the momentum and ensure the long-term success of highway development initiatives under the ERGP. With continued commitment and effective implementation, the ERGP can pave the way for a modern and efficient highway network that supports Nigeria's economic growth and development.

The Vision 20-2020 was a long-term development plan introduced by the Nigerian government to position the country as one of the top 20 economies in the world by the year 2020. Though the target year has passed, the documents ideology in the road sector is still relevant with the planned development of an efficient and well-connected transport network to support economic activities and enhance mobility across the country.

Research carried out by Ugwuanyi G. O of the Michael Okpara University of Agriculture published in 2014 revealed that no single period of the development plan recorded a fully implemented laid down objectives due to lack of implementable plan. Equally, the research observed that some factors causing failures in the plans include the leaders' inability to transform planned policies to realities, diversion from original focus and poor budgetary allocation.

3.0 CRITICAL AREAS THAT WOULD SHAPE HIGHWAY INFRASTRUCTURE ROADMAP & IMPLEMENTATION

The outlook of highway infrastructure roadmap and implementation is envisaged to be shaped by the following:

3.1 PUBLIC-PRIVATE PARTNERSHIPS (PPPs)

Public-private partnerships (PPPs) offer a promising avenue for enhancing the development of highway infrastructure in Nigeria. By addressing funding gaps, accelerating project delivery and encouraging innovation, PPPs can foster sustainable development, promote economic growth and improve the overall quality of highway networks. Nonetheless, it is crucial for the government to establish a conducive policy and regulatory environment, facilitate fair risk allocation and strengthen capacity building efforts to maximize the potential benefits of implementing PPPs in Nigeria's highway infrastructure sector.

The President Buhari administration made significant progress at kick-starting the use of PPPs in road development with the launch of the Highway Development and Management Initiative (HDMI). Nine (9) concession projects were approved by the Federal Executive Council (FEC) towards the end of

“...in the road sector is still relevant with the planned development of an efficient and well-connected transport network...”

the President Buhari's administration. The current administration would need to urgently conclude with the Full Business Case (FBC) and reach a Financial Close. This would usher in the long-awaited construction and operational stage of PPP projects at the Federal level and boost investor confidence in the use of PPP model for road development in Nigeria.

The PPP model would further engender innovations from the concessionaires such as intelligent transport systems (ITS) to enhance traffic management, improve road safety and optimize travel efficiency as well as a sustainable road maintenance regime. To bolster and entrench the use of PPP models for road infrastructure development in Nigeria, the Federal Government would need to enlighten the top echelon of public officers in the road sector on the fundamentals of PPP projects. In so doing, they will become champions in promoting and implementing the projects, thus eliminating possible rejection, bureaucracy and delays that may arise as due to lack of full knowledge of the process.

3.2 MONITORING OF HIGHWAY ROADMAP IMPLEMENTATION

The recent administrations have laid emphasis on the monitoring of projects by creating and strengthening Monitoring and Evaluation Units for infrastructure implementation establishments. However, a wholistic review of the overall implementation of the country's development plans is seldomly done. Subsequent administrations are not in the habit of reviewing the level of implementation of earlier development plans before originating new ones. Preference is given to being an originator of a development plan rather than auditing the level of implementation of previous ones and refocusing it in line with changing trends. Also, the development plans have suffered a fundamental challenge of aligning them with the yearly budget. The Legislature has the cardinal responsibility to appropriate funds for execution of projects by the Executive. It has been observed that the development plans are not given the deserved consideration when the yearly appropriation is

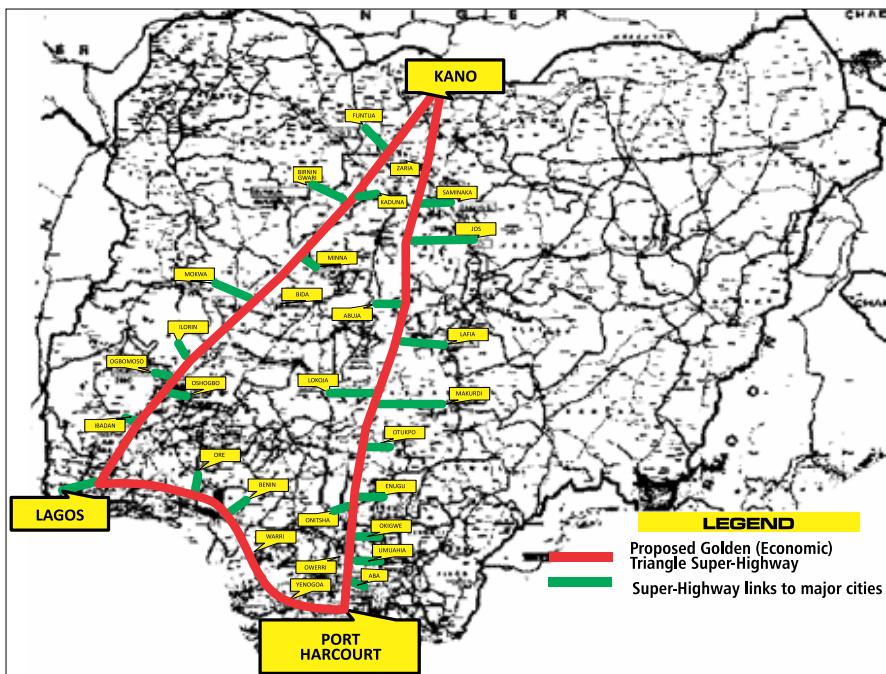


Fig. 1: Map of Nigeria showing the Golden Triangle Super-Highway. Source: FMW, HM Presentation

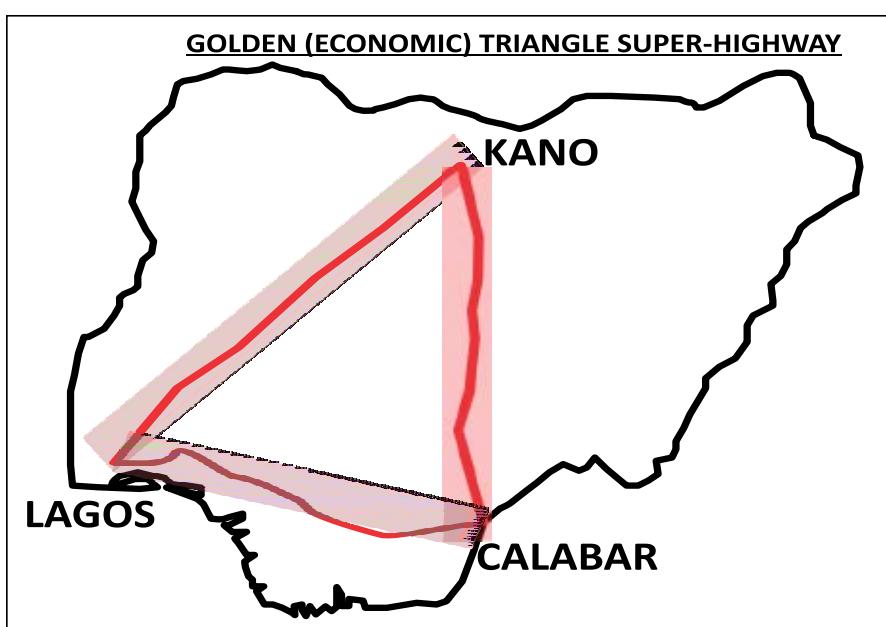


Fig. 2: Map of Nigeria showing the Golden Triangle Super-Highway extended to Calabar. Source: FMW, HM Presentation.

being done. This leads to poor budgetary allocation to projects in the implementation plan with resources allocated to projects outside the plan. The ministry in charge of budget and national planning has a pivotal role to play in reversing this trend. Their monitoring mechanism for implementation of developmental plans needs to be given a front seat going forward in order to track and assess the impact and periodically enlighten the Executive of the progress and achievements of the plan. Further to this, they need to midwife the aligning of appropriation activities of the Legislature to the development plans of the Executive. The creation of a separate Ministry for Budget and National Planning by the present administration is expected to give impetus to aligning the yearly budget with development plans of the country. Monitoring of development plans would equally be in perspective and increase the chances of its actualization.

3.3 CONNECTING THE COUNTRY'S ECONOMIC HUBS AND GIVING ATTENTION TO RURAL FEEDER ROADS

According to Adewumi (2008), road transportation in Nigeria controls over 95% of all surface transportation with a total asset base of over N3 Trillion. In a review by Yolas Consultants, over 80% of Nigeria's road network are under state level and estimated to be over 160,000km. However, insensitivity has marred rural roads development, perpetuated by road engineers, professionals, users and politicians at state and national levels. Collectively, they have ignored the important role rural life and rural economy plays in ensuring a more tranquil country and buoyant economy. Likewise, the direct highway connection of economic hubs and industrial/agricultural clusters around the country has not advanced from government whitepapers to the actual construction of the highways. The first bold attempt in the recent past to develop such super highway in Nigeria was promulgated by the President Goodluck Johnathan's administration with the plan to develop the Golden Triangle Super-Highway. The highway was planned to connect major coastal cities such as Lagos, Port-Harcourt and Calabar to Kano and Kaduna in Northern Nigeria with links to the Abuja and other important cities as well as industrial and agricultural hubs. The concept was first developed to directly connect Lagos, Port-Harcourt and Kano (See Fig. 1) and later extended to connect Calabar (See Fig. 2).

Nigeria's Golden Triangle Super-Highway was modelled after India's

Golden Quadrilateral Highway network that connects several major industrial, agricultural and cultural centres of India. The highway forms a quadrilateral with the four metro cities of India namely: Delhi(north), Kolkata (east), Mumbai (west) and Chennai (south). Fig. 3 shows India's Golden Quadrilateral (GQ) Highway network. An extensive work done by Ejaz Ghani, Arti Grover Goswami, William R. Kerr and published in 2015 revealed that the GQ substantially increased India's manufacturing activity amongst other social and economic activities.

The President Tinubu's administration has taken the strategic step to implement Nigeria's Golden Triangle project starting with the Lagos - Calabar Coastal Highway of 700km in length. The contract for the Phase 1 (Section 1) which starts from Ahmadu Bello Way and terminates at Eleko Village Area in the Lekki Peninsula (47.474KM) was awarded by the Federal Executive Council (FEC) on Monday 26th February 2024 and the contractor has commenced the construction works.

Other strategic roads that would define Nigeria's economic landscape when fully implemented include:

- The Bodo-Bonny Road:** The road which is under construction is about 38km long and the project is nearing completion. The road is being funded by Nigeria LNG Ltd under the Tax Credit Scheme and links the mainland Rivers State to the Bonny Island that serves as a global liquified natural gas (LNG) production hub.
- The Badagry – Sokoto Highway:** This road was conceptualized under Nigeria's 4th National Development Plan. Construction commenced in 1978 but abandoned in 1979. The highway provides a direct link from Lagos to Sokoto and transverses 7 states namely: Lagos, Ogun, Oyo, Kwara, Niger, Kebbi and Sokoto States. It equally provides international gateway to West African countries and the northern part of Africa with enormous economic and life transforming potentials.



Fig. 3: Map of India showing the Golden Quadrilateral Highway network.
Source: Timesproperty.com

3.4 CONSTRUCTION MATERIALS, EQUIPMENT AND MANPOWER

The highway construction industry in Nigeria is dominated by expatriates with over 10 of the largest construction companies having foreigners as their Managing Directors. Expatriate contractors are engaged more on large-scale construction projects leaving the indigenous contractors to small-scale projects despite Nigeria's Local Content Policy and the expatriate quota system. This also limits the opportunities for indigenous contractors to participate in big projects that will enhance their capacity. A study carried out by Opeoluwa Akinradewo, Douglas Aghimien and Clinton Aigbavboa, with sample space of Ekiti State, identified that Indigenous contractors recorded fewer cost overrun on road projects executed compared to expatriate contractors. Furthermore, expatriate contractors repatriate most of their earnings which contributes to income generation and distribution shortages. Nigeria would need to galvanize existing policies and possibly formulate new ones aimed at catapulting indigenous contractors in the road sector to dominate the industry. The drive to achieve this would be hinged on the need to turn the tide of income generation and distribution that would ensure that indigenous contractors control the major share of earnings in the

industry and reduce earnings that expatriates send to their home countries. Moreso, it will reduce the pressure on FOREX and promote capacity building of indigenous contractors.

The recent devaluation of the Naira presents a good opportunity for local manufacturing and assembling of construction equipment as well as the need to harness and research on use of local materials in the highway industry. Trucks are currently being manufactured in Nigeria by companies like Dangote Sino Truck West Africa. There is room for manufacturing of other heavy duty construction equipment like excavators, roller vibrators, pay loaders etc to meet the demand occasioned by increased provision of infrastructure and shortage of FOREX in the country. Also, Nigeria has abundance of bitumen deposit in Ondo State located in South Western Nigeria which has a proven reserve of about 42.47 billion tonnes of bitumen yet to be explored. This is an area that is ripe for investment which promises good return on investment as there is ready market in Nigeria and the West African region. Nigeria equally needs to ramp up production of steel and cement which are critical components in the road construction industry noting that the country has raw materials for these products in commercial quantities.

3.5 IMPROVING FUNDING BY PROVIDING ‘RING-FENCED FUNDS FOR ROAD DEVELOPMENT

Due to other competing needs of the government, it has been established that funding highways solely from government treasury is not adequate and sustainable. Consequently, various administrations over the years have come up with alternative means of highway funding such as Buyers preferential credit, SUKUK Fund Sharia-Compliant Bond-Like Financial Instrument), loans from multinationals, Road Infrastructure Development and Refurbishment Investment Tax Credit Scheme and Toll Fee collection. Toll collection was truncated in January 2004 with the demolition of the toll gates. The Road User Tax which was enshrined in the FERMA Act of 2004 was not implemented.

A research carried out by E. Izunobi in 2016 revealed that countries like Kenya and Namibia with less matured governance perform better in providing quality road network with the use of a ring-fenced

funding method administered by a road fund board and a separate autonomous road agency for executing projects. For countries like USA and France with more matured governance, the use of ring-fenced funding does not make a difference in quality of their road network. Nigeria has made attempts to establish a Ring-Fenced Fund for road development with the Wey Commission report of 1972, Road Vision 2000 report of 1996. These reports promoted the creation of a Road Fund for road maintenance in the country. Their argument was that having a Road Fund provides a sustainable and steady fund for maintenance making planning easier and project execution efficient. The recommendation was partly implemented with establishment of the Federal Roads Maintenance Agency (FERMA) as a stopgap to precede the full road reform. However, the Road Fund and Road Fund Board were not established and the challenge of efficient road maintenance still persists.

Nigeria has commenced the ring-fencing of funds with the creation of the Nigeria Infrastructure Fund (NIF) which is one of three distinct and ring-fenced funds managed by the Nigeria Sovereign Investment Authority (NSIA). The Fund covers highways amongst other critical infrastructure and its impact has been felt in the road sector with the execution of 3 notable projects namely, the 2nd Niger Bridge, Lagos – Ibadan Expressway and Abuja – Kaduna – Kano Highway. The success of the ring-fenced funding has encouraged the Tinubu Administration to approve a new Infrastructure Development Fund, tagged, “Renewed Hope Infrastructure Fund”. This was approved at the Federal Executive Council (FEC) meeting on March 25, 2024. The fund is aimed at facilitating effective infrastructure development across the critical sectors including agriculture, transportation, ports, aviation, energy, healthcare and education.

For a more sustainable funding of the road sector, Nigeria would need to create a self servicing Ring-Fenced Road Fund that would be replenished with earmarked revenue sources such as road user tariffs from vehicle fines, heavy goods vehicle levy, vehicle ownership fee, international transit fee and luxury car tax. Further to this, the government is expected to continue promoting the Road Infrastructure Development and Refurbishment Investment Tax Credit (Tax Credit) Scheme. The Tax Credit Scheme

is already yielding lots of positive results in the road sector with players like the NNPC Ltd, MTN and Dangote Group embarking on funding of several critical projects under the scheme. Many more companies are anticipated to get involved in the scheme to improve road infrastructure that would facilitate their business and uplift the lives of citizens within the environment.

4.0 CONCLUSION

The performance of the highway (roads) sector in Nigeria has not been satisfactory despite its enormous potentials for growth and development. Traditionally, the poor transport facilities and infrastructure have severely delayed economic development. This has contributed negatively to attempts towards alleviating poverty in the country. Recent highway development roadmaps advocate strategic investments, more collaboration with the private sector through PPPs and embracing innovative/home grown technologies. The strategic investments would be more effective in the rehabilitation of existing federal trunk roads and building direct highway links to major economic hubs in the country with connection to industrial/agricultural clusters. The Federal Government showed a renewed focus in this direction in the 2023 supplementary budget with 35% of the budgeted funds dedicated to the provision of critical infrastructure and allocated to the Federal Ministries of Works (for highway projects), the Federal Capital Territory and Housing & Urban Development. Also, more funds have been allocated for capital expenditure in the 2024 budget. The government equally aims to increase infrastructure stock as a percentage of GDP from just over 30% to around 70% by 2043 and to leverage public-private partnerships to finance and execute key projects. However, the construction sector faces many challenges, such as the volatile macroeconomic environment, the high inflation and exchange rate, regulatory bottlenecks, security risks and the seemingly low investor confidence and foreign direct investment. These factors limit the availability and affordability of construction materials, equipment and labour, as well as increase the costs and risks of infrastructure projects.

The future of highway infrastructure roadmap and implementation would depend on the ability of the government to address current challenges and

create a more conducive and attractive environment for infrastructure development. Monitoring and evaluation of the development plans must be prioritized going forward. This is cogent to track and assess the impact and periodically enlighten the executive arm of government of the progress and achievements of the plan. Further to this, the yearly Appropriation of the Legislature should be consciously aligned to the programs in the development plan of the Executive.

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"THE CONSULTING ENGINEER" PERSONALITY

ENGR. DR. ILESANMI O. BANKOLE (*FNSE, FNIHTE, FIICA, MASCE*)

CEO, SANOL ENGINEERING CONSULTANTS LTD

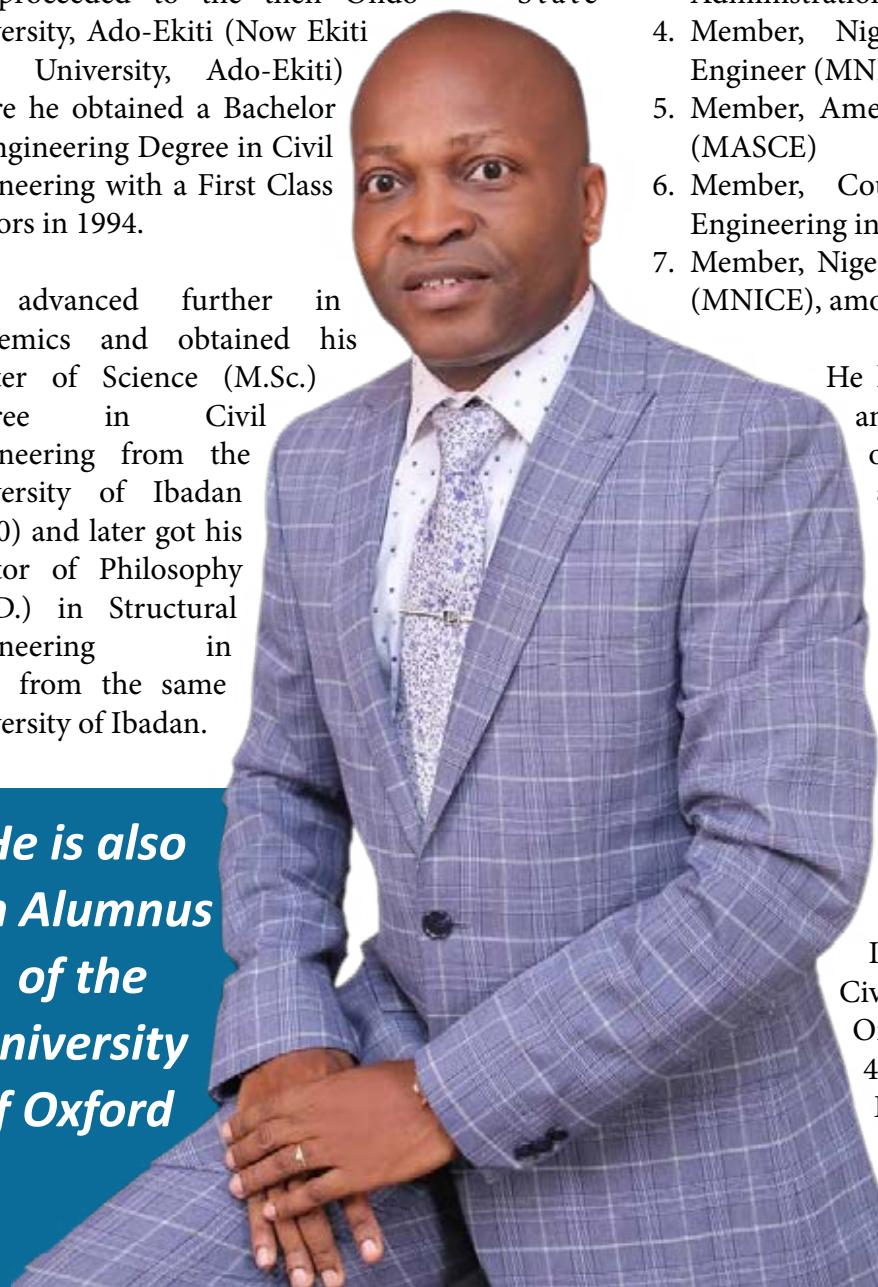
Engr. Dr. Ilesanmi Olorunfemi Bankole, COREN registered engineer, started his education in Local Authority Primary School, Ifon, St. Saviours Primary School, Owo (1980) and later proceeded to Imade College Owo, Ondo State where he obtained his Secondary School Certificate.

His postsecondary academic studies started in Federal Polytechnic Ado-Ekiti where he obtained a National Diploma in Land Surveying in 1987.

He proceeded to the then Ondo State University, Ado-Ekiti (Now Ekiti State University, Ado-Ekiti) where he obtained a Bachelor of Engineering Degree in Civil Engineering with a First Class Honors in 1994.

He advanced further in academics and obtained his Master of Science (M.Sc.) Degree in Civil Engineering from the University of Ibadan (2000) and later got his Doctor of Philosophy (Ph.D.) in Structural Engineering in 2007 from the same University of Ibadan.

***He is also
an Alumnus
of the
University
of Oxford***



He is also an Alumnus of the University of Oxford Business School where he obtained the Oxford Advanced Management and Leadership Program Certificate in July 2010.

Other International and Local Professional Certifications include:

1. Fellow, Nigerian Society of Engineers (FNSE)
2. Nigeria Institution of Highway and Transportation Engineers (FNIHTE)
3. Institution of Industrialists and Corporate Administration (FIICA)
4. Member, Nigeria Institution of Structural Engineer (MNISTRUCT E)
5. Member, American Society of Civil Engineers (MASCE)
6. Member, Council for the Regulation of Engineering in Nigeria (MCOREN)
7. Member, Nigeria Institution of Civil Engineers (MNICE), among others.

He has attended several conferences and trainings both within and outside the country. Some of them are:

1. Project Finance and Financial Analysis Techniques for Infrastructure Projects - Institute of Public-Private Partnerships (IP3) Training Courses, Washington, DC
2. Structural Engineering Institute of the American Society of Civil Engineers Structures Congress, Austin Texas
3. Structural Engineering Institute of the American Society of Civil Engineers Structures Congress, Orlando, Florida
4. 141st Annual Civil Engineering Conference of the American Society of Civil Engineers Structures Congress, Memphis, Tennessee
5. First T & DI Congress

- of the American Society of Civil Engineers, Chicago, IL
6. Structural Engineering Institute of the American Society of Civil Engineers Structures Congress, Pittsburg, Pennsylvania
 7. Steel and Concrete bridges design to BS 5400: Organized by Thomas Telford Training,

London. (A subsidiary of Institution of Civil Engineering, London), among others.

His career experience in Engineering was acquired in topnotch organizations, among which are;

1. Profen Consultant Inc. Ibadan
2. Pentagon Engineering Consultants Ltd, Efbee Contractor Ltd Ibadan
3. Federal Roads Maintenance Agency, Abuja where He worked as an I.T Consultant.

He started his own Engineering Consultancy practice in 2005 under the name, Sanol Engineering Consultants, a consultancy firm specializing in planning, feasibility studies, design, training, supervision and project management in: Highway & Transportation, Bridges, Concrete & Steel Structures, Foundations & Geotechnics, Water Supply & Waste, Flood & Erosion Control, Master Plan & Architectural Design, Irrigation & Dams, Sewage & Solid Waste and Oil & Gas.

Over a hundred projects have been successfully completed for both the Federal & State Governments of Nigeria and for the United States of America Government in Nigeria including Private Organizations and Corporations. Such as North South Power Company Ltd, Skye Bank etc.

He is also the Managing Director of Precon Smith Construction Limited, an international Engineering Construction firm with expertise in Roads, Bridges, Building, Water, Steel Fabrication and other Infrastructural works. The company has successfully implemented several roads and bridge projects for the Nation. Engr. Bankole also seats on the Board of other Corporate Organizations.

His integrity and commitment towards humanity in many spheres of life have earned him lots of awards and recognitions among which are: Award of Recognition as a Legacy Driven Professional in the Construction Industry Hall of Fame by

"He started his own Engineering Consultancy practice in 2005 under the name, Sanol Engineering Consultants, a consultancy..."

Construction & Engineering Digest (CED) 2019; Meritorious Honour Award (Nigerian Institute of Civil Engineers) - Abuja Chapter. 2018; Yoruba Youth Leadership Award (Yoruba Youth Assembly) 2018; Certificate of Excellence as "Icon of Nation Building" (Arewa Youth Advocacy for Good Governance – AYAGG) 2018; Award of Excellence (Development of Youth Initiative of Nigeria) 2018; Award of Exceptionality (NAOSS) University of Abuja Chapter, 2016; Meritorious Hon. Membership Award (Sons of David Foundation Int'l - SODAFON) 2015; Chief Obafemi Awolowo 2013 Leadership Award (National Association of Oodua Students – NAOS).

Dr. Bankole is the Resident Pastor of Household of Love Church, Abuja, a multi-dimensional ministry under the leadership of Rev. Yinka Yusuf devoted to bringing men into the knowledge of Christ and liberating them from the power of sin, sickness, affliction and poverty through the transforming power of the Holy Spirit.

He is a Philanthropist and the President of Greenfield World Mission International, a mission support and charitable organization through which he has brought succor to the poor, hungry, the sick and the lost.

He achieved this through Free Skill Acquisition Training program where people were trained in several entrepreneurial skills; Free Medical Outreaches where the sick received free medical care, eye glasses and free surgical services; Free Charity Outreaches for distribution of foodstuffs to the poor, etc. As part of his desire to contribute to the society, he built and donated a 4-Rooms clinic named Nkoli Memorial Clinic for the people of Akwana in Kaduna State.

He is happily married with children.

A WORD FOR YOUNG ENGINEERS

BY ENGR. DR. BANKOLE ILESANMI O. (FNSE, FNIHTE, FIICA, MNISTRUCT.E, MASCE.)

INTRODUCTION

We live in a generation of fast lane living. Nowadays, many young engineers and other young people are in a hurry to succeed because of great investment into their lives and the current economic hardship facing the nation, coupled with the hopelessness of getting a job after graduation. The 'make-it-quick' syndromes no longer start after four years pupillage as a young engineer but from the university as an undergraduate.

This Internet and information technology age has opened up several opportunities for young people to seek alternative way of achieving their goals. Engineering is an interesting profession. You are not likely to achieve wealth or success in the first few years of practice till you practically master the profession.

I, therefore, give the following advice to our young people in the Engineering Profession:

- i. **Defer gratification:** If you rush in receiving gratification, you will lose status quickly and will be too proud to find your level when the time comes. While growing up in my university days we had some friends who moved from the Engineering profession into Banking or Accounting for the purpose of making money fast, while some of us remained in the profession and paid the price for it. In less than 5 years, those banks began to collapse, and many lost their jobs and could not proceed in the banking sector and at the same time could not return to Engineering.
- ii. **Be diligent:** Diligence is a virtue not many people can boast of. It is a state of persistency in sticking to a goal until it is attained without giving up. The Engineering profession is the king of profession among its peers because of unlimited opportunities for the diligent. If you are thorough and persistent, you will get to the peak.
- iii. **Do not major in minor and minor in major:** Determine your priorities in life and not be intimidated by the so-called difficult field of Engineering. The more difficult the problems you solve, the more greatness and success you achieve. The easier fields of specialisation are often crowded while the seemingly difficult fields have less competition, thus ranking you climb faster.
- iv. **Pursue your goals:** Every life goal is achievable within the Engineering profession. Wealth, satisfaction, professionalism, fulfilment etc. are attainable.
- v. **Finding satisfaction in the profession:** Know that the fate of many people hangs in your hand for movement of goods and services, light and electricity generation, improving the quality of life of people and being able to make life meaningful to mankind as a result of your ingenuity. Nothing brings more satisfaction than making life better for humanity.
- vi. **Be focused:** Focus is keeping your gaze on the finish line and on the goal without distraction. Many obstacles and distractions will be encountered on the path to achieving your career objective. But you must be focused.
- vii. **Be innovative:** Do not settle down for the norm in life but seek to push the boundaries forward through research and innovative ideas. Many new technologies are yet to be discovered while there are more ingenious ways of solving a problem yet to be discovered. I was once confronted with the option of demolishing a structure that was only defective on the slab but with good foundation and columns because of long abandonment due to water seepage from the roof. Through innovation, we were able to salvage the building by replacing the slab without necessarily demolishing the entire building.
- viii. **Mentorship:** Allow yourself to be properly mentored. Your early exposure to the Engineering profession under the pupillage of an experienced Engineer will go a long way to help you in your career. You don't need to re-invent the wheel but you can stand on the shoulder of giants to see clearer and farther in life.
- ix. **Seek more knowledge:** A first degree in Engineering is good, but an additional degree where possible is better. It will help to enhance your career and professional development. I did not know anything about modelling and simulation in my Engineering career as an undergraduate but the postgraduate studies opened my eyes to that area, which is almost like the key way of analysis and design today. There are things you will never know until you add more knowledge.
- x. **Be industrious and enterprising:** Academic knowledge alone is not enough. The knowledge of business climate and the adaptability of your knowledge into entrepreneurship are important. The Engineering profession does not just constrain you to the employment market. It also gives you the advantage of job creation and being an employer of labour. Many great Engineers in our world today are entrepreneurs in the field of consulting, construction, etc. With the challenges of low job prospects, instead of looking for employment all your life, you can create one for yourself.



Engr. Dr. Bankole Ilesanmi

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EXECUTION OF RAILWAY LINE PROJECTS IN NIGERIA: ACHIEVING SUSTAINABILITY & SAFETY BY NEXANT CONSULTING LIMITED

1.0 INTRODUCTION

Railway infrastructure is an important component in Nigeria's transportation network. Railway lines provide an efficient mode of transportation, facilitating the movement of passengers and freight across long distances. In Nigeria, where road congestion and inadequate road networks are prevalent, railways offer a reliable alternative, connecting major cities, ports and industrial hubs. The development of railway infrastructure stimulates economic growth by reducing transportation costs, enhancing trade activities and promoting industrial development.

By providing efficient access to markets and raw materials, railways support agricultural production, manufacturing activities and export-oriented industrial ventures. The resultant benefits are job creation and wealth generation. Nigeria seeks to position itself as a regional economic powerhouse. To achieve this status, the modernization and expansion of railway networks are crucial for enhancing the country's competitiveness in the global market. Efficient railway transportation reduces transit times, lowers logistics costs and improves the competitiveness of Nigerian goods in international markets. This translates to attracting investments and promoting trade relations with neighboring countries and beyond.

2.0 SUSTAINABILITY AND SAFETY OVERVIEW

The significance of sustainable and safe railway projects in Nigeria extends far beyond mere transportation. These projects represent transformative investments with far-reaching implications for economic competitiveness, social inclusion and environmental stewardship. By connecting people, communities and markets, railways serve as conduits for trade, commerce and social interaction, bridging geographical

divides and unlocking new opportunities for growth and prosperity.

In this context, the execution of railway line projects in Nigeria holds immense promise for catalyzing sustainable development and fostering inclusive growth. By prioritizing sustainability and safety in the planning, design and implementation of railway infrastructure, Nigeria can harness the full potential of its vast resources, optimize transportation efficiency and improve the quality of life for its citizens.

This article delves into the critical importance of sustainable and safe railway projects for Nigeria's economic growth and social development. Through an in-depth analysis of key factors influencing the execution of railway line projects, examination of case studies and formulation of actionable recommendations, it seeks to underscore the imperative of prioritizing sustainability and safety in Nigeria's railway infrastructure agenda.

3.0 OVERVIEW OF ONGOING AND COMPLETED RAILWAY LINE PROJECTS

- i. **Lagos - Kano Standard Gauge Railway Line:** This railway line connects Lagos, Nigeria's commercial capital, to Kano, a major economic hub in the northern region. The project is one of the largest railway modernization initiatives in Nigeria, with ongoing construction works across multiple phases. See Fig. 1.



Fig. 1: Lagos - Kano standard gauge railway line. SOURCE: Railwaygazette.com

ii. **Abuja - Kaduna Railway Line:**

This railway line links the federal capital, Abuja, to Kaduna, a key city in Nigeria's northwest region. The railway line became operational in 2016, representing one of the first modern standard gauge railway projects completed in Nigeria. See Fig. 2.

iii. **Lagos - Ibadan Railway Line:**

This railway line connects Lagos to Ibadan, a major city in southwestern Nigeria, with extensions planned to other regions. See Fig. 3. The project is currently under construction, with significant progress made in the laying of tracks, construction of stations and installation of signaling systems.

iv. **Itakpe - Ajaokuta - Warri Railway Line:**

This railway line links the iron ore mining town of Itakpe to Ajaokuta and Warri, two important industrial cities in Nigeria's south-central and southwestern regions, respectively. The rehabilitation and modernization of the existing narrow gauge railway line have been completed, with plans for further expansion and integration into Nigeria's broader railway network. See Fig. 4.

v. **Port-Harcourt - Maiduguri Railway Line:**

This railway line spans from Port-Harcourt, a major seaport city in the south, to Maiduguri, the capital of Borno State in northeastern Nigeria. The project is in the planning and feasibility study stage, with discussions ongoing regarding funding, route alignment and technical specifications.

vi. **Lagos Rail Mass Transit (LRMT) Project:**

The LRMT project consists of several lines designed to serve different parts of Lagos State, including the Red Line, Blue Line and others planned for future development. The project is undergoing various stages of planning, construction and expansion, with the Red Line being the most advanced in terms of implementation.



Fig. 2: Abuja - Kaduna railway line. SOURCE: [Thecable.ng](#)



Fig. 3: Lagos - Ibadan railway line. SOURCE: [Premiumtimesng.com](#)



Fig. 4: Itakpe - Ajaokuta railway line. SOURCE: [Wikipedia.org](#)

"This railway line links the iron ore mining town of Itakpe to Ajaokuta and Warri, two important industrial cities..."



Fig. 5: Lagos blue line. SOURCE: Arise.tv

Fig. 5 shows the Lagos Blue Line.

4.0 MEASURES TO REVITALIZE THE NIGERIAN RAILWAY SYSTEM

- i. **Rehabilitation of Existing Lines:** One of the primary efforts to revive rail transportation in Nigeria involves the rehabilitation of existing rail lines. This initiative focuses on upgrading tracks, bridges and stations to improve safety, reliability and operational efficiency. Projects such as the Lagos - Kano and Port-Harcourt - Maiduguri lines are undergoing extensive rehabilitation to enhance capacity and facilitate seamless movement of passengers and freight.
- ii. **Construction of New Railway Lines:** In addition to rehabilitating existing lines, Nigeria is investing in the construction of new railway lines to expand the rail network and improve connectivity. Key projects include the Lagos - Ibadan standard gauge rail line, which will significantly reduce travel time between Nigeria's economic hub and the southwestern region. Other planned lines include the Abuja - Kaduna - Kano line and the Coastal Railway line, linking major cities and ports across the country.
- iii. **Modernization of Rolling Stock:** Efforts to revive rail transportation in Nigeria include the modernization of rolling stock, including locomotives and railcars. The procurement of new, modern trains equipped with advanced technology improves passenger comfort, enhances safety and increases operational efficiency. Additionally, the refurbishment of existing rolling stock extends their lifespan and enhances performance, ensuring reliable and sustainable rail operations.
- iv. **Public-Private Partnerships (PPPs):** To accelerate the revitalization of the rail sector, Nigeria is leveraging public-private partnerships (PPPs) to attract investment and expertise. Collaborations with international companies and financiers bring in much-needed funding and technical know-how to support railway projects. PPP models are being employed for the construction, operation and maintenance of rail infrastructure, driving efficiency and innovation in the sector.
- v. **Integration with Other Modes of Transport:** Reviving rail transportation in Nigeria involves integrating rail networks with other modes of transport, such as road, air and maritime. Intermodal terminals and logistics hubs are being developed to facilitate seamless transfer of passengers and goods between different modes of transport. This integrated approach enhances connectivity, reduces congestion and improves the efficiency of the transportation system as a whole.
- vi. **Adoption of Modern Technologies:** The adoption of modern technologies is playing a crucial role in the revival of rail transportation in Nigeria. Digital signaling systems, GPS tracking and automated ticketing solutions improve safety, efficiency and customer satisfaction. Additionally, the deployment of electrification and renewable energy sources reduces environmental impact and enhances sustainability in rail operations.
- vii. **Capacity Building and Skills Development:** Efforts to revive rail transportation in Nigeria include capacity building and skills development initiatives to equip the workforce with the knowledge and expertise needed to operate and maintain modern rail infrastructure. Training programs, partnerships with educational institutions and knowledge transfer from international experts enhance the capabilities of railway personnel, ensuring the long-term success of the sector.
- viii. **Regional Integration and Cross-Border Cooperation:** Nigeria is actively pursuing regional integration and cross-border cooperation in its efforts to revive rail transportation. For example, the Lagos - Kano - Dakar Railway Project is aimed at connecting Nigeria with neighbouring countries to promote trade and enhance economic cooperation. Collaboration with regional partners on rail

infrastructure development fosters mutual benefits and strengthens diplomatic ties across borders.

5.0 FACTORS INFLUENCING SUSTAINABILITY AND SAFETY

- i. **Environmental Considerations:** Before commencing railway projects, comprehensive environmental impact assessments (EIAs) are essential to evaluate potential environmental effects. This involves assessing impacts on ecosystems, water resources, air quality, noise levels and biodiversity. EIAs help identify sensitive areas and potential risks to environmental sustainability. Based on the findings of EIAs, mitigation strategies are implemented to minimize adverse environmental impacts. This may include measures such as reforestation, wetland restoration, noise barriers, and pollution control systems. Additionally, sustainable construction practices, such as minimizing soil erosion and waste generation, are adopted to reduce environmental harm during project execution.
- ii. **Technological Advancements:** Technological innovations in safety systems play a crucial role in enhancing safety within railway projects. Advanced signaling systems, automatic train control systems and collision avoidance technologies improve operational safety and reduce the risk of accidents. Additionally, the implementation of safety protocols, such as emergency response procedures and employee training programs, further enhances safety standards.
- iii. **Track Maintenance:** Regular maintenance of railway tracks is vital to ensuring safe and efficient operations. Technological advancements in track inspection, monitoring and maintenance equipment, such as ultrasonic testing and track geometry measurement systems, enable early detection of defects and proactive maintenance interventions. By addressing issues like track degradation, rail wear and alignment irregularities, these technologies enhance the longevity and safety of railway infrastructure.
- iv. **Regulatory Framework:** Adherence to regulatory safety standards is paramount to ensuring the safety of railway projects. Governments and regulatory bodies establish safety regulations, codes and standards that

govern various aspects of railway infrastructure, including design, construction, operation and maintenance. Compliance with these standards helps mitigate safety risks and ensures consistency in safety practices across projects.

- v. **Community Engagement:** Meaningful engagement with stakeholders, including local communities, indigenous groups and other affected parties, is essential for building trust, addressing concerns and fostering social acceptance of railway projects. Consultative forums, public hearings and community feedback mechanisms provide opportunities for stakeholders to voice their opinions, express concerns and participate in decision-making processes.
- vi. **Social Impact Assessment:** Conducting social impact assessments (SIAs) helps identify potential social risks and opportunities associated with railway projects. SIAs evaluate the project's potential effects on communities, livelihoods, cultural heritage and socio-economic dynamics. By understanding community needs and aspirations, railway projects can be designed and implemented in a manner that maximizes social benefits and minimizes adverse impacts.

6.0 CONCLUSION

The execution of railway line projects in Nigeria stands as a transformative opportunity, with the potential to reshape the nation's transportation landscape with due consideration to promoting sustainability and safety. By prioritizing environmentally friendly technologies, stringent safety measures, job creation and effective PPPs, Nigeria can establish a robust and modern railway network that serves as a catalyst for economic growth and national development. The successful implementation of these projects will not only connect cities but also connect Nigeria to a more sustainable and prosperous future.

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4. https://en.wikipedia.org/wiki/Warri%20-%20Itakpe_Railway
5. <https://www.arise.tv/lagos-blue-rail-line-to-start-operations-september-4/>



ANKABUT ENGINEERING LIMITED

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Mobile:

+2348036135515, +2348029151854

Email:

ankabuteng@gmail.com

CORPORATE PROFILE

ANKABUT ENGINEERING LTD (RC 839484) operates with the following vision, mission and core values:

VISION

To be a leader in engineering and construction business and committed to building long term relationships by providing exceptional construction services.

MISSION

To be a world class construction company committed to total customer satisfaction, by building our strengths, innovative projects, superlative quality of materials,

cutting edge technology, timely completion and demonstrating the highest standards of workmanship. We aim to be the most reliable, trusted & efficient provider of construction services in the industry.

CORE VALUES

- Putting Safety First
- Delivering Excellence
- Creating Opportunities for Our People
- Acting with Integrity
- Building Inclusive and Diverse Community



**Engr. Kam-Selem Alhaji Bukar, FNSE,
FNICE, FNIHTE, PE, M.ASCE
(MD/CEO, Ankabut Eng. Ltd.)**

OVERVIEW AND SERVICES

ANKABUT ENGINEERING LTD is an integrated multi-disciplinary company formed to provide a wide range of services for the construction industry. ANKABUTENGINEERING LTD is a Consulting and Project Management expert capable of handling and providing consultancy services to projects of any magnitude in the fields of:

(i) Construction

(ii) Architecture

(iii) Quantity Surveying

(iv) Civil and Structural Engineering

(v) Mechanical and Electrical Engineering

(vi) Project Management

Our clients cut across both the public and private

sectors of the Nigerian economy.

We have been involved on a wide variety of building and civil engineering projects in different parts of the country in conjunction with other partners.

The company can boast of highly experienced professionals in fields mentioned earlier, and have worked in various parts of Nigeria and all are registered with the relevant professional bodies in the construction industry.



Human resources



Housing project

PROFESSIONAL SERVICES OFFERED

ARCHITECTURE

- Single and multifamily housing
- Industrial buildings
- Institutional and Health facility buildings
- Hotels and other tourist services projects
- Airport and transit services
- Commercial and office developments
- Community centres
- Sporting and recreational facilities
- Restoration of colonial and monumental structures
- Ecological studies
- Land use planning
- Streets, parks and external landscape design of areas.

QUANTITY SURVEYING

- Advice on the probable cost at the inception stage of a project, including assistance in the establishment of the design brief.
- Advice on what size and standard of structure can be erected for any given expenditure.



Construction site



Highway project

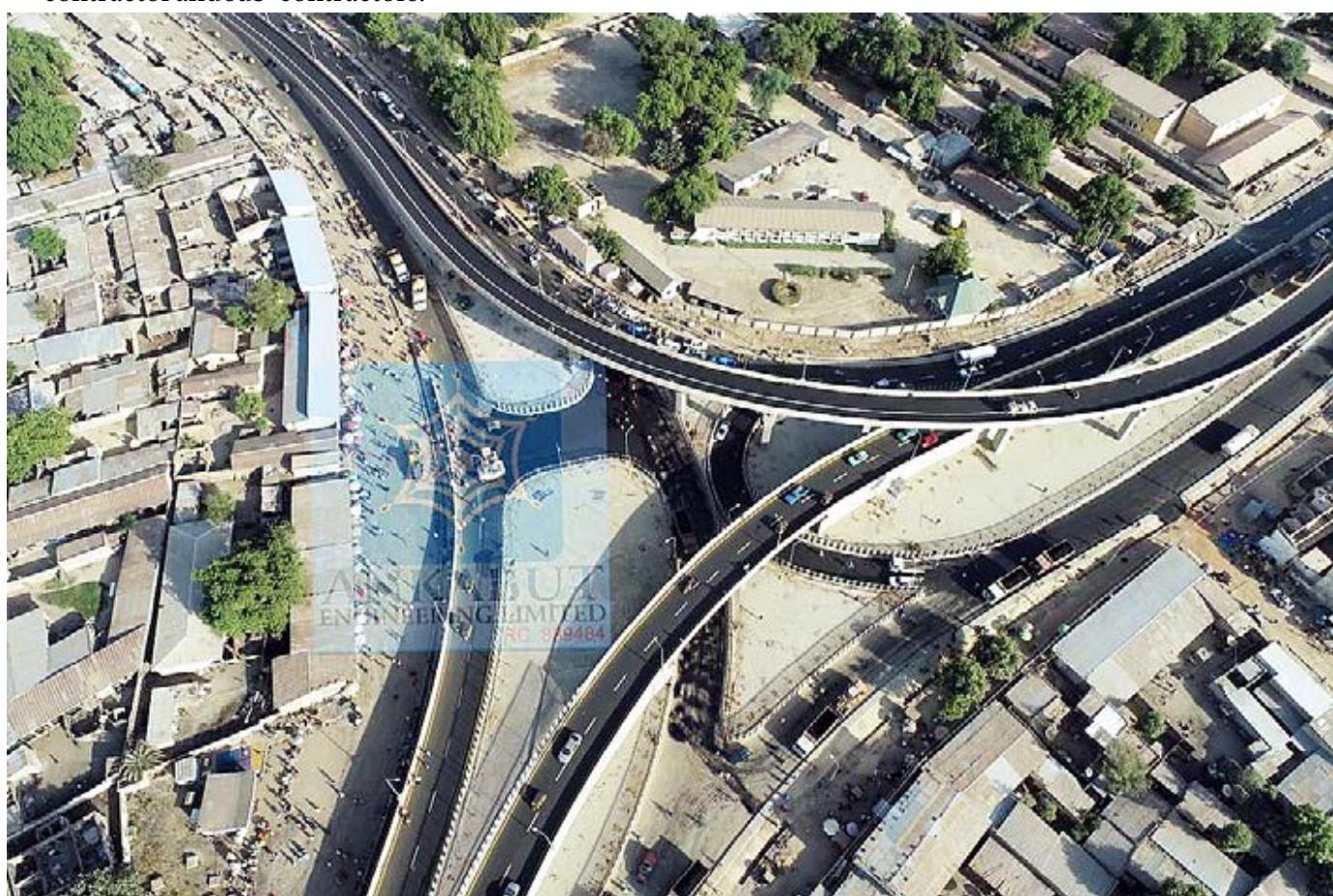
- Design/cost analysis to establish economy in the use of resources.
- Project/cost analysis of the implications of phasing and programming the work.
- Cost planning during the development of design, including periodic updating of cost estimates.
- Advice on tendering procedures and contractual arrangements
- Responsibility for, or assistance in, the preparation of tender documents, including conditions of contract and bills of quantities or other basis for the selection of the contractor and specialist sub-contractors and the subsequent financial administration of the contract.
- Examination and reporting of tender prices and advice on selection and appointment of contractor and sub-contractors.
- Pricing and negotiating a contract with single tender (if required).
- Measuring of work including adjustment of variations, valuing for interim certificates and preparation and agreement of final account.
- Total cost coordination, including forward estimating analysis of proposed changes, assessment of admissible cost fluctuations, cash flow projections and interim financial statements to assist client's financial control.



Construction of pillar structural support for flyover



Survey at project site



Flyover network

TABLE OF SOME EXECUTED PROJECTS

S	PROJECT	YEAR	CLIENT	INPUT	STATUS
1	Construction of Three Hundred (300) Capacity lecture hall	2011	Umar Ibn Ibrahim El-Kanemi College of Education, Science and Technology, Barma	Design and Supervision	Commissioned
2	The Completion of Maiduguri Central Mosque Complex	2011	Maiduguri Central Mosque Implementation Committee	Structural Engineer/ Resident Consultant	Commissioned
3	Procurement of Equipment for Federal Veterinary Medical Centre, Borno State	2017	Federal Ministry of Agriculture and Rural Development	SUPPLIER	Commissioned
4	Construction Projects in North East	2018	SKYE BANK PLC	Project Management	Commissioned
5	Establishment of Centre Pivot Sprinkler Irrigation Scheme in Tudun Wada LGA, Kano State	2018	Hadejia-Jama'are River Basin Dev. Authority	Consultancy Supervision	Commissioned
6	Construction of Health Information Complex	2018	FMC, NGURU	Consultancy services	Commissioned
7	The Supply of 150 KVA Generator to NEDC Headquarters	2019	North-East Dev. Commission	Supplier	Supplied
8	Construction of College of Medical Sciences	2019	Yobe State University, Damaturu, Yobe State	Consultancy services	Commissioned
9	Consultancy Services for the Construction of Flyover Bridge Being Undertaken by M/S EEC INTERNATIONAL LIMITED AT CUSTOM ROUNDABOUT, MAIDUGURI	2020	Borno State of Ministry of Works	Consultancy Services	In progress
10	Construction of Gongulong-Zabarmari-Dusuman-Galameri Feeder Roads & Rehabilitation of Jiddari Polo Road and Drainages Project	2020	Construction of Gongulong-Zabarmari-Dusuman-Galameri Feeder Roads & Rehabilitation of Jiddari Polo Road and Drainages Project	Supervision	Commissioned
11	Construction of Five (5) Block of Four House of (2) Bedroom each (115-119) for the Returning of Internally Displaced Persons (IDPs) at NGWON MAFA, LGA, Borno State.	2020	North-East Deve. Commission	Project execution	Completed
12	Provision and Installation of Thirty (30Nos) Integrated Solar Street lights at Abuja Women Centre, FCT Abuja	2021	Nigerian Ports Authority	Project execution	Completed
13	Consultancy Services and Supervision of Four (4) Selected Roads within Maiduguri Township	2022	Ministry of Works, Musa Usman Secretariat, Maiduguri, Borno State	Consultancy services and supervision	Ongoing
14	Consultancy Services for Supervision of Rehabilitation of Dilapidated Buildings and Construction of New Facilities in FSTC, Lassa	2022	Project Implementation Unit IBSDLEIP Science and Technology Education Department, Federal Ministry of Education, Abuja FCT	Supervision	Ongoing
15	Construction of Perimeter Fence with Gate House at the Proposed COREN Office in Maiduguri, Borno State	2022	Council for the Regulation of Engineering in Nigeria (COREN)	Project execution	Ongoing
16	Contract for the Repairs of Workshop and Laboratory Equipment	2023	Kano State Polytechnic (Office of the Rector)	Project execution	Ongoing
17	Contract for the Renovation of Classrooms	2023	Kano State Polytechnic (Office of the Rector)	Project execution	Ongoing

CIVIL AND STRUCTURAL ENGINEERING

- Construction
- Feasibility studies
- Pre-investment surveys and reports

- Detailed designs, drawings and specifications
- Appraisal of existing infrastructures & prescription of remedial measures
- Supervision of construction

MECHANICAL AND ELECTRICAL ENGINEERING

- Feasibility studies for new projects and upgrades
- Preliminary Design and cost estimation
- Power systems analysis
- Detail design and drafting
- Preparation of Equipment specifications and vendor review
- Construction documents and specifications
- Construction and commissioning support

PROJECT MANAGEMENT

Coordinate all consultants and contractors services at both pre-contract and post-contracts stages. This involves:

- a. Pre-contract stage: Taking brief from the client; if required, assisting the client to appoint other consultants; preparing program of works for pre-contract documentation; arranging all necessary soil tests and reports; checking and vetting of all

contract documents and cost plans at various stages including getting approvals from clients and relevant authorities; arranging pre-qualification of contractors and sub-contractors and necessary interviews; preparing cash flow projections; assisting the client, if required, in securing bank loans for property development; vetting of tender reports; arranging and coordinating the execution of contracts.

- b. Post-contract stage: Handing over of sites to contractors and checking and vetting same; checking and vetting interim valuations and payments certificates; checking of quality of work for compliance with specification; vetting variation orders before their issuance to the contractor and sub-contractors for overall project cost-control; checking all measurements and re-measurements for final account purposes; checking of consultant fees; taking over project on completion.

ANKABUT ENGINEERING EDUCATIONAL TRUST



Ankabut scholarship awardees with Engr. Kam-selem (2nd from right)



Engr. Kam-selem(l) on inspection at a scholarship examination centre



Ankabut scholarship exam in progress



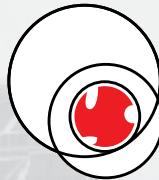
Scholarship award to thirty engineering students



Ankabut scholarship exam

We guarantee quality engineering services

Our firm is richly endowed with a superb combination of world class professional expertise and integrity which reliably guarantee quality delivery of projects to the delight of our growing number of clients.



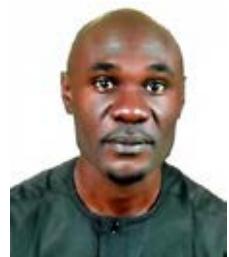
YOLAS CONSULTANTS LTD

ENGINEERS, PLANNERS AND PROJECT MANAGERS

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THE ROLE OF GEOTECHNICS IN CURBING FAILURE OF STRUCTURES

BY ENGRS. MUDASHIR SHITTU & AYOTOPE DARAMOLA



1.0 INTRODUCTION

The greatest risks to a structure leading to failure are the things which are not seen. They lie beneath the subsurface. Hence, there is always a need to ensure that what lie beneath are adequately mapped and ascertained in terms of their behavior and response to loading under various conditions before structures are built on them.

Geotechnics is an important prerequisite carried out to ascertain the stability of structures whether large or small. In our world today, particularly in developing countries of which Nigeria is an example, a lot of assumptions are being made in respect to the behavior of the soil and the bearing strength of the subsurface strata on which the structures lie. It is sometimes observed in detailed design notes on foundation design that some assumptions are made by the designer. Example is: "Assumed bearing capacity of 150 kN/m²." A geotechnical engineer has to question the premise of such an assumption. Geotechnical investigations are necessary before any structure is constructed to avoid danger of any

instability of the structure and safety of occupants. Few years ago, there was a fact finding investigation that was carried out on the collapsed Oko Bridge in Kwara State, Nigeria. It was discovered that no site investigation was done at the time. Investigations after the bridge collapse revealed that the center pier of the bridge was actually resting on some isolated rock boulders that were not continuous. During raining season, scouring of the rock boulders around the pier occurred and before the next raining season, a lot of scouring has happened at the center pier and it caved in causing a collapse of the bridge. See Fig. 1. This eventually led to a total reconstruction of a new bridge. The isolated rock would have been removed and the foundation of the center pier would have been placed at a stable depth with continuous rock strata if a detailed geotechnical investigation had been carried out. A significant cost could have been saved and the failure of that bridge would have been prevented.

2.0 WHAT IS GEOTECHNICAL SITE INVESTIGATION?

Detailed planning is the key to the success of any project when it comes to construction and infrastructure development. There are salient and unseen matters that actually play vital roles in safety and stability of structures. One of these crucial aspects of a construction project is geotechnical site investigation. Geotechnical investigation involves assessing the properties and conditions of the soil, rock and groundwater at a construction site. It allows engineers to make informed decisions, mitigate



Fig. 1: Collapsed Oko Bridge, Kwara State, due to differential settlement on mid pier.

“One of these crucial aspects of a construction project is geotechnical site investigation.”

risks and ensure effective cost management and the success of a project. Before any structure is built, engineers need first to assess the ground on which the structure is to be placed. This is to see if the ground is suitable and suitable enough to safely begin construction of the structure. The process of probing and ascertaining what lies beneath the subsurface where the structure is to be built is called geotechnical site investigation.

It gives information on the physical properties of soil and subsurface details for proposed structures and for the repair of distress to earthworks that are caused by subsurface conditions. The information from this process help clients to save huge costs. Ultimately, this investigation seeks to understand the soil conditions below the surface, which entail and include the type of soils or rock beneath the subsurface, behavioral pattern of the subsoil and its properties in terms of strength and deformation, groundwater conditions and its effects on the subsurface strata, other engineering problems and properties. The various subsurface conditions of the site determine construction design details, including the type of foundation suitable for the structure, cost of the construction works, how the structure will be built, etc. Hence, not minding how small or massive the intended structure is, a geotechnical investigation must be carried out to ensure safety and stability of the structure.

Construction planning is mostly accompanied by geotechnical site investigation, although in most cases little attention is given to it or often overlooked. The investigation will reveal the properties of the soil, such as how much weight it can bear, how easily it can deform under loading and how porous it is. The ground supports the foundation on which structures are built. According to the Institution of Civil Engineers (ICE – UK), the greatest technical and financial risks to development occur within the foundations and the ground itself. “A 2015 study discovered that 37% of all industrial building projects and 50% of commercial building projects suffer delays due to ‘unforeseen ground conditions’. All of this could be easily avoided with a geotechnical site investigation.”

The conditions of the ground on a site vary from one point to another. This is because of the heterogeneous nature of soil over a short distance and the differences in its composition from one point to another within a single plot of land. Therefore, wrong assumptions in the design parameters and properties of soil within a locality pose a calamity in waiting. Geotechnical investigation will reveal if there could be an environmental issue in terms of drainage from one point to another within a single site. The consequence is the impact on how the land will react to new development. The response of soil to loading at various seasons differs due to the amount of moisture they carry per time. Geotechnical investigations are important when it comes to various considerations on how a soil stratum will react to loading. The considerations are discussed below:

- i. Composition of the Subsoil Strata: A detailed investigation allows you to highlight issues that are not immediately obvious during construction, but that might affect the stability of the structure during its service life. Without a proper and detailed investigation, one could end up with long term deformation or ground movement which will create problems for any structures built on the land. A land made up of soft soils or that has been previously filled and not well compacted can create stability issues with development as it settles over time.
- ii. Stability of the Ground: Beyond ascertaining the bearing strength of the subsurface strata, geotechnical investigations assess surface and groundwater drainage conditions. The reports produced also outline the impact that the proposed structure would have. Also, due to variation in climate, unusually high rainfall can have an impact on the stability of the land significantly over time. A detailed investigation will show the behavioral pattern of the soil in terms its stability under imposed pressure and variation in moisture content of the various strata before construction.
- iii. Site History: Geotechnical site investigations explore the things that have occurred within a particular site over the years. The history of a site gives

valuable insight into how it will potentially behave with additional development. For example, in areas where mining activities had previously been carried out, there is a high tendency for imminent collapse, if the area was not properly reclaimed in line with required standards. Apart from mining activities, other site historic conditions that affect the stability of structures are abandoned dump site, ground contamination, trapped gases, etc. Geotechnical investigations aim at fully assessing the risks and providing adequate remedial and ground improvement measures prior to commencement of construction.

iv. Ground Movement: Piping of loose sediments, soil shrinkage, swelling, basement excavation, vibration, ground shaking and activities or response of soils to moisture variation can all cause ground movement and lead to failure of structures. Geotechnical investigations give insight into the potential ground movement which may occur on site. It also assesses the impact of development on structures close by. The site investigations ensure that the right measures are put in place to prevent any disaster that might occur due to the response of the subsurface strata to any of the factors that can cause ground movement.

Understanding soil properties, groundwater levels and ground conditions allows engineers to



Fig. 2: Geotechnical Investigation process with in-situ tests (SPT)

make informed decisions during the design and construction phases. By investing time and resources into site investigation, engineers can mitigate risks, optimize designs and ensure that construction projects proceed smoothly.

3.0 GEOTECHNICAL SITE INVESTIGATION PROCESS

The cost implication of carrying out geotechnical investigations for any project is very small in comparison to overall project cost. In most cases, it is usually less than 1% of the project cost.

A detailed geotechnical site investigation consists of borehole drilling in several places and assessing many trial pits appropriate to the size of the development. See Fig. 2. These, alongside testing for contamination and other ground investigations, relevant to the proposed development, constitute the best in a project development. Most often, the more samples and data collected, the better the chance of identifying ground hazards.

The geotechnical site investigation process are:

- Desk Study:** This essentially is a preliminary enquiry conducted to gather existing information about the site, including geological maps, previous investigations and any recorded ground-related issues. This stage helps engineers plan and optimize subsequent investigation activities while identifying potential areas of concern.
- Field Investigation:** This stage involves conducting various tests and collecting samples to assess the ground's conditions. Some common

techniques include drilling boreholes to retrieve soil and rock samples, conducting in-situ tests and measuring groundwater levels. It also involves studying the topographic conditions and assessing any visible signs of

"The cost implication of carrying out geotechnical investigations for any project is very small in comparison..."



Fig. 3: A digital laboratory setup for analysis of soil properties.

geological factors that may affect construction. The data collected from these tests form the basis for subsequent analysis and design decisions.

iii. Laboratory Testing: After the site investigation, the collected soil and rock samples are taken to the laboratory for various tests (See Fig.3). The samples are analyzed in the laboratory to determine their composition, physical properties, strength, deformation, compaction, permeability, drainage and other relevant characteristics. This set of data helps engineers refine their understanding of the site conditions and make accurate predictions for the project's success. The details provided on the properties and behavior of the strata equip the engineers with critical information for designing foundations and other structural elements.

iv. Geotechnical Analysis: Using the data gathered from site investigations and laboratory tests, engineers perform geotechnical analysis. This includes evaluating factors like bearing capacity, slope stability, settlement, swelling and seepage potential. By simulating real-world scenarios, engineers gain insights into how the soil will behave under different loading conditions.

v. Reporting and Recommendations: The final stage of the geotechnical investigation process involves compiling all the collected data, analyzing the set of data and preparing a comprehensive report. This report includes an interpretation of the findings, recommendations for suitable foundation types, design and construction, earthwork considerations and an assessment of potential risks.

4.0 ROLE OF GEOTECHNICAL PROPERTIES OF SOIL IN PREVENTING FAILURE OF STRUCTURES

Structures like bridges, buildings, dams, roads, tunnels, towers, etc. are founded beneath the ground surface. In order to ensure stability, appropriate founding soil is required. For various projects, it is necessary to carry out detailed assessment of geotechnical properties of subsoil in order to generate relevant data for design and construction of foundations for the structures.

Taking into account the quantum of the intended structure, it is expedient to allocate some amount for detailed sub-surface exploration than to overdesign the building based on assumptions, thereby making it more expensive. The engineering properties of the soils for different strata encountered at the site are used in evaluating the most appropriate type of foundation that will be suitable for the proposed structure. For example, if the foundation of a structure is built on compressible soil, it leads to settlement. The knowledge of the rate at which the compression of the soil takes place is essential from design consideration. Properties of soil such as plasticity, compressibility or strength of the soil always affect the foundation design in the construction. See Fig. 4.



Fig. 4: Shear failure at a bridge pier in Gombe due to soil movement beneath the base

The loading capability of soil depends upon the type of soil and its strength. Plasticity index and liquid limit are the important factors that help an engineer to understand the consistency or plasticity of clay. Though shearing strength is constant at liquid limits, it varies for plastic limits for all clays. Also, the rate of permeability of soil influences its drainage characteristics and in turn affect the stability of the structures. The shear strength of soils is of special relevance among geotechnical soil properties because it is one of the essential parameters for analyzing and solving stability problems like earth pressure, the bearing capacity of footings and foundations, slope stability or stability of embankments. Evaluating the interactions among different geotechnical properties of soil and their influences on structures is vital in curbing failures of structures and saving costs of construction works.

5.0 INTERACTION OF GEOTECHNICAL PROPERTIES OF SOILS

The various properties of soils have different influences on the structures built on them. These properties are interdependent and need to be effectively assessed in order to arrive at the design parameters to ensure stability of structure. The properties can be classified under index properties, strength properties and deformation properties. These properties are discussed as follows:

- i. **Specific Gravity:** It is an index property of soil. It is the ratio of the mass of soil solids to the mass of an equal volume of water. It is an important index property of soils that is closely linked with mineralogy or chemical composition and reflects the history of weathering. It is relatively important as far as the qualitative behavior of the soil is concerned. It is useful in soil mineral classification. It gives an idea about

suitability of the soil as a construction material; higher value of specific gravity gives more strength for roads and foundations. Researches show that an increase in specific gravity can increase the shear strength parameters. It is also used in calculating void ratio, porosity, degree of saturation and other soil parameters that are essential in foundation design and construction.

- ii. **Relative Density:** It is a measure of the degree of compactness and the stability of a stratum. It expresses the ratio of actual decrease in volume of voids in a sandy soil to the maximum possible decrease in volume of voids i.e. how far the sand under investigation is capable of further densification beyond its natural state. Its determination is helpful in compaction of coarse grained soils and in evaluating safe bearing capacity of sandy soils.
- iii. **Consistency Limits:** The consistency of a soil is largely influenced by the water content of the soil. A gradual decrease in water content of a fine-grained soil slurry causes the soil to pass from the liquid state to a plastic state, from the plastic state to a semi-solid state and finally to the solid state. The water content at these changes of state varies for different soils. The water content results in transition from one state to the next known as the liquid limit, the plastic limit and the shrinkage limit. The water contents that relate to these changes of state are called the Atterberg limits.

The liquid limit of a soil is the water content, expressed as percentage of the weight of the oven dried soil, at the boundary between the liquid and plastic states of the soil. The plastic limit of a soil is the water content, expressed as a percentage of the weight of oven dried soil, at the boundary between the plastic and semi-solid states of the soil. Sand has no plastic stage, but very fine sand exhibits slight plasticity. The plastic limit is an important soil property. Soil is said to be in the plastic range when it possesses water content in between liquid limit and plastic limit. The range of the plastic state is given by the difference between liquid limit and plastic limit and is defined as the plasticity index. The plasticity index is used in soil classification and in various correlations with other soil properties as a basic soil characteristic. A decrease in attraction force causes liquid limit of the soil to decrease and accordingly plasticity index decreases. As the clay content increases, inter-molecular attraction force increases and liquid limit increases. The shrinkage limit is the maximum water content at which any further reduction in water content will not cause a decrease in volume of the soil mass. The finer the particles of the soil, the greater the amount of shrinkage will be. Soils that shrink and swell are categorized as expansive soils and have

"Consistency is an important property and is a useful measure for assessment of clay soils."

adverse effects on the stability of the structures built on them when water contents change due to seasonal variations.

Consistency is an important property and is a useful measure for assessment of clay soils. Plasticity and cohesion reflect the soil consistency and workability of the soils. These properties play an essential role in many engineering projects such as the construction of the clay core in an earth fill dam, the design of foundations, retaining walls and slab bridges and determining the stability of the soil on a slope.

- iv. **Particle Size Analysis:** It gives an idea regarding the gradation of the soil i.e. it is possible to identify whether a soil is well graded or poorly graded. The grain size analysis is widely used in classification of soils from fine to coarse soils, and largely in further improving on the description of the type of soils encountered. The percentage of coarse particles more than $75\mu\text{m}$ is determined by sieve analysis whereas less than $75\mu\text{m}$ is determined by hydrometer analysis. Based on the particle size analysis, the distribution curves are plotted which represent the distribution of particles of different sizes in the soil mass.

The data obtained from grain size distribution curves is used in the design and to determine suitability of soil for construction. Details obtained from particle-size analysis can be used to predict soil-water movement and other drainage characteristics. Very fine soil particles are easily carried in suspension by percolating soil water and under drainage systems are rapidly filled with sediments unless they are properly surrounded by a filter made of appropriately graded granular materials. The gradation and size of the sand affect the shear resistance. The particle shape will affect the shearing strength of soil. For instance, angular grains provide more interlock and increase shear resistance. Well-graded materials provide more grain to

grain area contact than poorly graded materials. Porosity and spaces available for clay within the sand is important while considering the mixtures of clays and sands in composite soils. The distribution of the particle sizes in a soil affects its behavior under loading because of its packing and bonding capacity.

- v. **Compaction:** Soil compaction is a property of soil that involves densification and reduction of voids in soil. It is one of the ground improvement techniques. It is a process of expending compaction energy on soil to force the soil grains to be more closely rearranged. Compaction increases the shear strength of soil and reduces its compressibility and permeability. Compaction of soils increases the density, shear strength, bearing capacity but reduces their void ratio, porosity, permeability and settlements. The moisture content at which the soils are compacted in the field is controlled by the value of optimum moisture content determined by the laboratory proctor compaction test.
- vi. **Permeability:** Permeability has an important role on the properties and behavior of soil as it deals with the rate and the amount, of distribution and movement of water in soil. The principles of fluid flow come into play on construction projects. Water pressure is always measured relative to atmospheric pressure and water table is the level at which the pressure is atmospheric. Soil mass is divided into two zones with respect to the water table; below the water table (a saturated zone (100% saturation) and above the water table (called the capillary zone) saturation $\leq 100\%$). Data from permeability tests are needed in the design of structures due to variation of groundwater.

This helps in ascertaining the pumping capacity for dewatering excavations and in obtaining aquifer constants. The permeability of soils has a decisive effect on the stability of foundations, seepage loss underneath the base, embankments of reservoirs, drainage of subgrades, excavation of open cuts in water bearing sand and rate of flow of water into wells. Water flowing through soil exerts considerable seepage forces which have direct effect on the safety of hydraulic

"The shear strength of a soil is of prime importance for foundation design."

structures. Also, shear strength of soils depends indirectly on its permeability because dissipation of pore pressure is controlled by its permeability. The rate of settlement of compressible clay layer under load depends on its permeability.

vii. Consolidation: This is a compressibility property of the soil and relates to the ability to undergo deformation and settlement under loading. The main aim of a consolidation test is to obtain soil data which are used in predicting the rate and amount of settlement of structure founded on clay primarily due to volume change of the soil. Settlement is the combination of time-independent and time-dependent compression. When a soil layer is subjected to compressive stress due to imposed loads, it undergoes compression, caused by rearrangement of particles, seepage of water, crushing of particles and elastic distortions. Settlement is one major issue that affects stability of a structure and can easily lead to failure. Settlement of a structure is analyzed for three reasons: appearance of structure, utility of the structure and damage to the structure. Visible sign of cracks on a structure is a failure sign on that structure showing sign of underground movement or tilt on the structure due to settlement. Further movement beyond tolerable limits can cause a structure to fail and collapse. The apparent increase in pressure results in consolidation, even though there is no increase in external load. Vibrations also have a densification effect on soils and lead to subsequent settlement. The effects can be severe when the vibration frequency matches the soil's natural frequency. Soils often fail and settle disastrously as a result of underground movements such as earthquakes and landslides.

viii. Shear Strength: The shear resistance of soil is the result of friction and the interlocking of particles and bonding at the particle contacts. The shear strength of soil depends on the effective stress, drainage conditions, density of the particles, strain rate and direction of the strain. The shearing strength is affected by the consistency of the materials, mineralogy and grain size

distribution, particle shape, initial void ratio and features such as layers, joints, fissures and bonding. The shear strength of a soil is of prime importance for foundation design. It affects the nature and type of foundation to be used. It is highly complex because of various factors involved in it such as the heterogeneous nature of the soil, the water table location, drainage and nature of construction stress of the project.

EFFECTS OF SOIL BEARING CAPACITY, FOUNDATION SETTLEMENT & UNDERGROUND WATER MOVEMENT

The prevention to the failure of a structure is guided by the behaviors of subsurface strata it rests on. Various properties of the soil serve as guide in determining the appropriate foundation type. Bearing capacity, settlement and underground water movement affect the choice of foundation to be used for a structure. Foundation types are broadly categorized under shallow and deep foundations. Shallow foundations include Isolated or Combined Pad Footing, Strip and Mat types. Deep foundations include Piles and Drilled Shaft types. Soil type and load bearing are critical factors to consider when choosing a suitable type of foundation. To select a foundation type that will give stability to the structure, the properties of the soil should be known, the loading combination of the structure that the foundation needs to carry must be ascertained and the design of the structural specifications like size, weight and depth must be put into consideration for overall safety.

The shear strength is the most important geotechnical property of soils. It controls the stability of structures on or below the subsurface. Consolidation properties of soils provide insight on the settlement phenomenon of structures. Permeability gives an idea about movement of water through the subsoil and how that can affect stability of structure. Knowledge of the interactions among different geotechnical properties of soils helps in design of foundations for different types of structures. Among the three phases of soil, only the solid phase controls the resistance to compression and shear. Water, present in a moist soil is highly

"Geotechnical studies are a fundamental component of sustainable development of infrastructure. It is an essential professional activity meant to curb failures of structures."

incompressible. As a liquid, it is not capable of resisting shear loads. Air present in unsaturated soils will not support compression or shear loads.

A structure can collapse due to foundation failure caused by soil with insufficient bearing capacity or improper foundation design. A building was investigated due to developed cracks when the construction had reached the plinth beam level. It was discovered that some foundations were located above the natural ground at a depth of 2 m in unconsolidated filled-up ground of an abandoned laterite stone quarry. Standard Penetration Test (SPT) was found to be less than 12 which resulted in differential settlement. This differential settlement was observed towards the front left corner of the building which was lying on the filled-up ground. The differential settlement led to cracks in the plinth beam and foundation concrete. An earlier site investigation would have detected this problem and appropriate foundation type would have been used to limit the effect of the settlement on the filled area. Another investigation was conducted at a residential building in Kaduna which had multiple cracks on the structure. The cracks occurred because of underground forces generated by vibrations and ground shaking by earth moving equipment during construction works of an adjacent structure directly behind the building. The transitional movement passes through the subsoil beneath the building causing displacement of underlying soil beneath the foundation (Soil liquefaction) and the portion with weak footings responded to the shaking transferring the settlement upwards from the ground floor up to the second floor of the left wing. The cracks were pronounced on the building wall due to settlement beneath its footings. Any further movement beneath the foundation footing would lead to collapse of the structure in the long run if no remedial measures were taken. Considering the scenario above, if the foundation were to be a mat foundation, the limit of the settlement will be even and vibration effects from adjacent area will have limited effect on the structure.

The scenario is a clear example that gives great insight into the role geotechnics plays in curbing failures of structures.

7.0 CONCLUSION

In summary terms, the key benefits of geotechnics can be listed as follows:

- i. Achievement of increased safety
- ii. Achievement of longevity and durability
- iii. Achievement of cost optimization
- iv. Achievement of sustainability
- v. Achievement of Structural stability and risk mitigation
- vi. Achievement of environmental hazard mitigation
- vii. Meeting the compliance requirements of regulatory authorities

Geotechnical studies are a fundamental component of sustainable development of infrastructure. It is an essential professional activity meant to curb failures of structures. It serves as a vital component in promoting eco-friendly urban development.

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ACEN ACTIVITIES IN PICTURES

1ST ACEN BUSINESS EVENING (14TH MARCH, 2024)



Engr. David Arinze, Guest Speaker presenting a paper at the event.



Guest Speaker, Engr. David Arinze receiving an appreciation plaque from the ACEN President, Engr. Kam-Selem A. Bukar, FNSE.



A cross-section of delegates at the event

2023 AGM



Special Guest, Engr. Shehu Hadi Hamad, FNSE, FNIOB, Executive Secretary, Federal Capital Development Authority (FCDA) receiving an appreciation plaque from the ACEN President (19th President), Engr. F. Ajibade Oke, FNSE



Keynote Address Speaker, Prof. Jonathan Adeyemi Aremu (Member, National Action Committee on AfCFTA; Consultant at ECOWAS Common Investment Market, Abuja) receiving an appreciation plaque from the ACEN President (19th President), Engr. F. Ajibade Oke, FNSE

2023 AGM



Group picture of 2023 AGM Planning Committee and Past Presidents of ACEN present at the event



Group picture of some of the members at the event



A cross section of participants.

INVESTITURE OF THE 20TH ACEN PRESIDENT 29TH FEBRUARY, 2024



ACEN President, Engr. Kam-Selem A. Bukar, FNSE, being decorated as the 20th President by the 19th President by Engr. F. Ajibade Oke, FNSE.



Shehu of Borno, HRH Alhaji (dr.) Abubakar Ibn Umar Garbai Al-Amen El-Kanemi, CFR flanked to the right by ACEN President, Engr. Kam-Selem A. Bukar, FNSE and other ACEN delegates to his Palace as part of the activities to the Investiture of the 20th President of ACEN.



Cross-section of participants at the Investiture of the 20th President of ACEN, Engr. Kam-Selem A. Bukar, FNSE.



ACEN President, Engr. Kam-Selem A. Bukar, FNSE

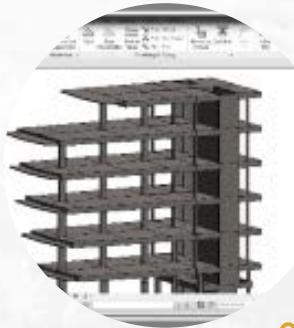
Group picture of dignitaries at the Investiture of Engr. Kam-Selem A. Bukar, FNSE as the 20th President of ACEN.

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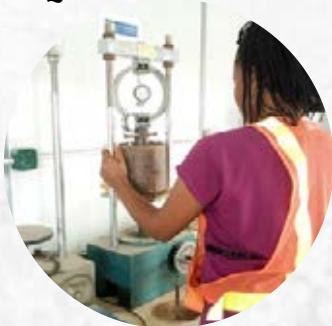
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Lagos Rail Mass Transit (LRMT) Blue Line Project



Lagos Rail Mass Transit (LRMT) Red Line Project



Re-construction of Lagos Ibadan Express Way (LIE)



ACEN FUTURE LEADERS' PERSPECTIVES ON DEVELOPMENT OF CIVIL INFRASTRUCTURE

BY ENGR. JOLAYEMI OYINLOYE

1.0. INTRODUCTION

Infrastructure has been defined by the Oxford Languages online dictionary as the basic physical and organizational structures and facilities (e.g. buildings, roads, power supplies) needed for the operation of a society or enterprise. Civil infrastructure systems involve the design, analysis and management of infrastructure that supports human activities, such as electric power, oil and gas, water and wastewater, communications, transportation and the buildings that make up urban and rural communities.

The process of creating and improving physical and organizational structures, such as ports, roads and logistics systems, to support economic activities is referred to as infrastructure development and this process is the subject of examination in this paper. There are diverse opinions on the state of infrastructure in Africa. This paper reviews the peculiarity of the state of infrastructure development in Nigeria.

2.0. STATE OF INFRASTRUCTURE DEVELOPMENT

It was reported by the World Bank that Infrastructure made a net contribution of around one percentage point to Nigeria's improved per capita growth performance in recent years, even though unreliable power supplies held growth back. The report opined that raising Nigeria's infrastructure endowment to that of the region's middle-income countries could boost annual growth by about 4 percentage points. It further reiterated that among its African peers, Nigeria has relatively advanced power, road, rail and ICT networks that cover the national territory quite extensively.

Although extensive reforms are ongoing in the power, ports, ICT and domestic air transport sectors, the challenges persist. The power sector's operational efficiency and cost recovery are considered to be among the worst in Africa, supplying about half of what is required, with subsequent social costs of about 3.7 percent of gross domestic product (GDP).

The combined water, sanitation and hygiene sector has inefficient operations as it is bedeviled with low and declining levels of piped water coverage. Irrigation development is also low relative to the country's substantial potential. In the transport sector, Nigeria's road networks are in deplorable condition due to lack



Engr. Jolayemi Oyinloye, MNSE, MNilStructE (President, ACEN Future Leaders Forum, Managing Director, Vasons Concept Consultants Limited)

of adequate maintenance. Also, the country has a poor record on air transport safety. The report estimated that addressing Nigeria's infrastructure challenges will require sustained expenditure of almost US\$14.2 billion per year over the next decade or about 12 percent of GDP. It is noteworthy that Nigeria already spends about US\$5.9 billion. Nigeria is well positioned to raise the funds needed for infrastructure, given the strength of the national economy, abundant oil revenues and efforts at electricity cost recovery and other improvements to operations and management.

Looking through the lens of the Africa Development Bank (AfDB) on the need for adequate infrastructure, Nigeria should aim to achieve: energy security, efficient transport, reliable communication systems, resilient sanitation and affordable housing.

Africa's vast infrastructure deficit has become a constraint on its growth but also presents an opportunity to leapfrog to new, more efficient technologies. AfDB agrees that as Africa becomes more urbanized, public goods will become easier and cheaper to deliver to a more geographically concentrated population but the key challenges will be to supply the burgeoning population with reliable electricity, affordable housing and transport infrastructure even though these industries will also create new jobs.

A brief review of the state of various infrastructure categories is presented below:

- i. **Housing:** Access to housing in Nigeria remains a persistent challenge, exacerbated by an inefficient mortgage industry, a burgeoning population, inflation, diminishing income and poverty, among other factors. As of 2023, the housing deficit stands at 28 million units, requiring an estimated N21 trillion to rectify the situation. Simply put, housing, where available, is simply not affordable for the vast majority.
- ii. **Energy:** Chronic electricity shortages have been a perennial problem in Nigeria, which has Africa's biggest economy and population. Nigeria is plagued with a woeful lack of generating capacity. In addition, part of the energy that is produced goes to waste because it cannot be distributed through the dilapidated grid. About two-thirds of the population still burn biomass for fuel which poses both health and environmental hazards.

iii. Transportation

- a. **Roads:** Roads are the main mode of transport carrying at least 80% of goods and 90% of passengers. 53% of the roads are unpaved, isolating people from basic education, health services, transport corridors, trade hubs and economic opportunities. Less than half of the rural population has access to all-season roads. Road safety is also a serious issue.
- b. **Rail:** Rail transport in Nigeria has suffered decades of neglect due to ineffective management. However, due to rising mobility demands accompanying population and economic growth and in a bid to boost productivity, the rejuvenation of the railways has gained priority in recent years. Outdated infrastructure and limited maintenance have undermined the effectiveness of our rail transport.
- c. **Air transport:** Air transport supports and provides a huge number of jobs and contributes significantly to the GDP. Some of the challenges facing the sector are bad management, closure of airports, decaying facilities, safety and security issues.
- d. **Ports:** Nigeria boasts of about seven ports out of which the Apapa and Tin Can Ports account for 70% of imports on average. The effect of not having efficient seaports is a serious problem that we can imagine the effect on the environment.
- e. **Information and communication technology:** The Information and Communication Technology sector in Nigeria has seen significant growth and development in recent years. The National Bureau of Statistics revealed that the sector contributed 18.44 percent to the nation's GDP in the second quarter of 2022.
- f. **Water Sanitation and Hygiene (WASH):** The overall status of the WASH sector in Nigeria is low. Only 9 percent of the population has access to complete basic WASH services. Those living in rural areas are two times more disadvantaged than those in urban areas. Fewer people have access to basic water, sanitation, and hygiene services in 2019 than in 2018. The statistics are disheartening as only 9% have access to basic water, sanitation, and hygiene services, 70% use basic drinking water services and the average per capita volume of water per day for the rural population stands at 9 liters, 44% use basic sanitation services, only 16% households have access to basic hygiene services, 14% of schools have basic water and sanitation services, 7% of our health facilities have basic water and sanitation services and over 46 million people still practice open defecation

3.0 ACEN FUTURE LEADERS' PERSPECTIVE

It is topical to present the perspective of ACEN Future leaders on the subject matter. Therefore, with every sense of responsibility, based on the aforementioned deficiencies and gaps in the provisioning of Civil infrastructure in Nigeria, we reiterate with concern this huge gap. Successive governments have been contributing piecemeal or nothing at all to the development of Civil Infrastructure in Nigeria. At times when they do contribute it is abysmally low, hence, the quadruple of deficiencies built up over the past years. Civil Engineering Infrastructure is a sine-qua-non to any meaningful physical development in any country. Therefore, there is a need to prioritize the development of Civil Infrastructure in Nigeria.

Furthermore, ACEN Future leaders believe that the government has not been able to harness the potential of Nigerian Engineers, especially the consultants. We are aware of a few policies - local content, executive orders, etc, to allow Nigerian Engineers to participate/partner with foreign Engineers in the execution of high net worth projects and through the same knowledge is transferred, exchanged and acquired. However, these policies appear not to be implemented as there has been no significant improvement in the participation of local firms in these large-scale projects. If this trend continues, the local technical capacity will diminish giving rise to high rate of job loss, unemployment and a mass exodus of young engineers to other countries.

It is pertinent to note that this trajectory of non-inclusiveness of Nigerian Engineers is at a high economic cost to the government – the foreign engineers/companies are paid in Dollars and they repatriate the money to their various countries. This depletes the country of the needed funds in circulation for trade and investment and in the long run, growth is either stunted or slow.

4.0 CONCLUSION/ RECOMMENDATION

It is imperative to be deliberate about the development of Civil Infrastructure. The government needs to set realistic milestones and be committed to achieving them. Infrastructural projects should be conceived on a need-to-do basis and competent indigenous firms should be involved in compliance with the extant laws or policies.

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TIT-BITS ON MAGNIFICENT INFRASTRUCTURE

1.0 INTRODUCTION

Infrastructure is said to be magnificent if its size or scope is considerably long or massive beyond the commonly available ones. There are some examples to be cited in Saudi Arabia, China and Nigeria.

2.0 THE LINE CITY IN SAUDI ARABIA

The Line City in Saudi Arabia is the largest super project in human history.



**Engr. Enefiok
Ubom, FNSChE**

Saudi Arabia is expected to spend US\$1.2 trillion to build a 'Line City' 170km long in a desolate desert. It consists of two parallel mirror walls each 500m high and 200m wide stretching across the Arabian desert, capable of accommodating 9 million residents. The entire city looks like a straight line from above hence, it is often referred by netizens as the 'Line City'. See Fig. 1.

The plan for the 'Line City' was announced

on January 10, 2021 by Saudi Crown Prince, Mohammed Bin Salman in a presentation that was broadcast on state television. Earthworks began in October 2021. By October 2022, bulldozers and excavators were digging foundations. See Fig. 2

The 'Line City' will consist of connected communities called modules. The total structure will consist of 135 modules of 800 metres each in length and 500 metres tall.

Reportedly, once completed the city will have three layers. The top layer is for residents, housing apartments, hospitals, schools, restaurants, entertainment venues, etc. People can walk to any public facility within 5 minutes in the residential layer to attend to their daily needs.

The middle layer is for business including shopping markets, communication facilities, offices, water and electricity facilities, etc.

In the bottom (transportation) layer, a 170km long high speed rail and sub-way system will be constructed. The city will have no cars emitting pollutants. All

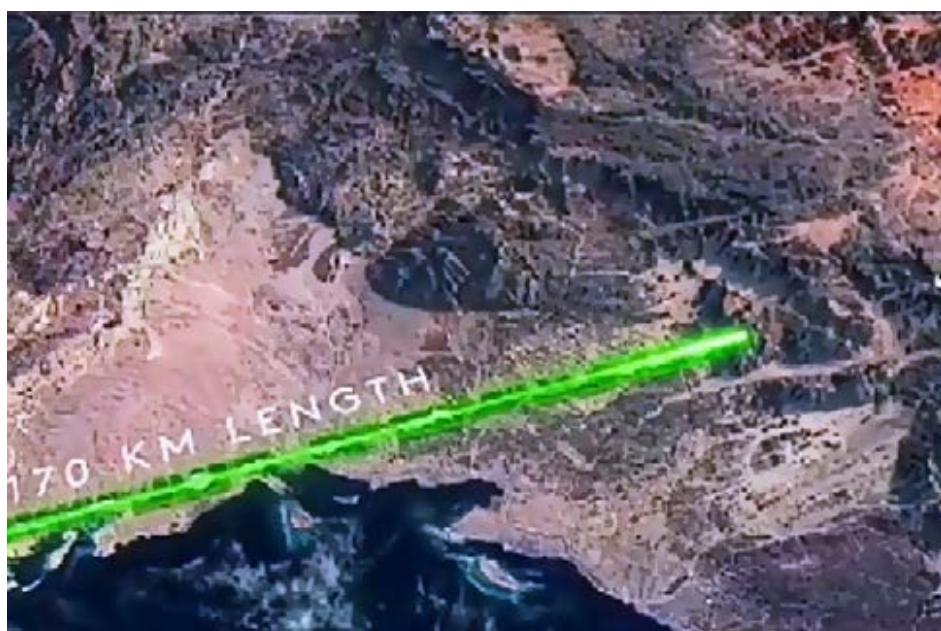


Fig. 1: A view of the 'Line City' in Saudi Arabia



Fig.2: Construction of the Line City in progress



Fig.3: The Jiaozhou Bay Bridge with interconnecting sections

energy will come from solar, wind and hydrogen ensuring 100% clean and pollution-free power. People can travel using the high-speed rail from one end of the city to the other end in just 20 minutes which is the advantage of a 'Line City'. It will also introduce vertical farming systems to provide people with fresh vegetables, fruits, grains and other crops. The Line City is a part of Saudi Arabia's vision 2030 aimed at shifting the country's economy from oil to tourism. It is a magnificent infrastructure in the making. (Source: Wikipedia)

The question is: "What is the lesson for Nigeria in all these?". The lesson comes from the statement: "All energy will come from solar, wind and hydrogen ensuring 100% clean and pollution-free power" The Nigerian landscape is dotted with residential estates. Estate developers in Nigeria should consider the use of clean energy solutions in newly developed residential estates as well as consider changing to clean energy in existing estates to improve the quality of life of the residents.

2.0 THE LONGEST BRIDGE IN CHINA

The longest bridge in China is the Jiaozhou Bay Bridge in Qingdao Shandong. China spent nearly a staggering US\$10 billion in its construction. Now some would wonder why China invested such an enormous amount of money in constructing such an outstanding bridge over the ocean. There is an ancient Chinese saying that holds the answer:

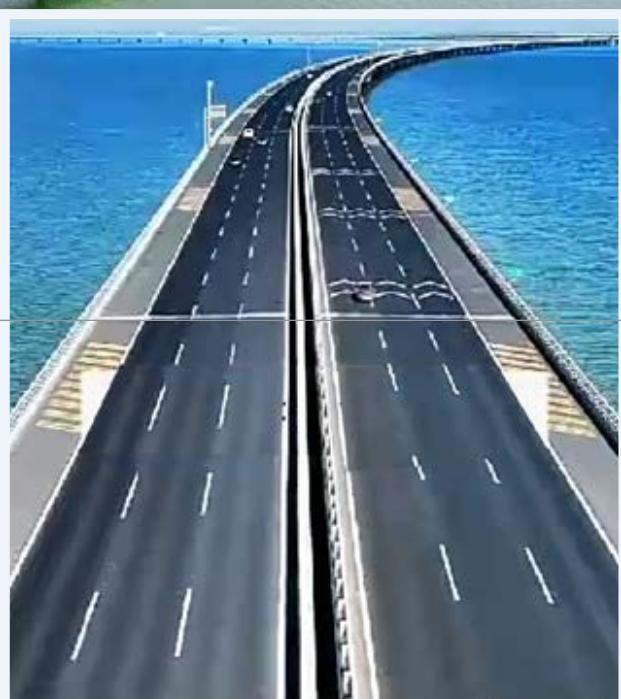


Fig. 4: The Jiaozhou Bay Bridge (Credit: Eagle Eye)

"If you want to get rich, build road first". In this context, roads also include bridges. This connotes that good road/bridge infrastructure paves the way to the progress of a country. China's unwavering determination to achieve this is nothing short of remarkable.

The Jiaozhou Bay Bridge is an engineering marvel spanning a jaw-dropping 42.23km. The bridge begins from the heart of Qingdao's urban area, glides past the enchanting Red Island and triumphantly reaches its destination at Yellow Island. The construction used 450,000 tons of steel and 2.3 million cubic metres of concrete. The bridge is designed to be able to withstand severe earthquakes, typhoons and collisions from ships. It is supported by 5,238 concrete piles. The cross section consists of two beams in total 35m wide carrying six lanes with two shoulders. See Fig. 3 & Fig. 4.



Fig. 5: A view of the route of the proposed 4th Mainland Bridge in Lagos.

The tenacity of over 30,000 dedicated builders who battled the elements from scorching heat to brutal cold even braving typhoons and snow storms for a relentless 4-year stretch is remarkable and demonstrates commitment to development. This structure is an epic testament to human ambition, dedication and insurmountable spirit of innovation.

SOURCE: https://en.wikipedia.org/wiki/Qingdao_Jiaozhou_Bay_Bridge

3.0 FOURTH MAINLAND BRIDGE IN LAGOS, NIGERIA

The Fourth Mainland Bridge is proposed to be 38km long and qualifies to be described as a magnificent infrastructure in today's terms in Nigeria when completed. The Governor of Lagos State, Babajide Sanwo-Olu, on January 25, 2024 said the construction of the long-awaited Fourth Mainland Bridge would begin by the end of March or April, 2024.

There are 7 things worthy of note about the long-awaited Fourth Mainland Bridge:

- i. The 38km-long bridge will connect Lagos Island through Langbasa and Baiyeku in Ikorodu across the Lagos Lagoon to Itamaga, in Ikorodu.
- ii. The bridge is a 2 x 4 lane carriageway cross-sectional road with permission for Bus Rapid Transit Lane and future road contraction.

- iii. The construction of the bridge will come 57 years after Lagos State creation on May 27, 1967 and 34 years after the delivery of the Third Mainland Bridge in 1990.
- iv. In December 2022, Lagos State, through the Office of Public Private Partnership, announced CCECC-CRCCIG CONSORTIUM as the preferred bidder for the proposed 4th Mainland Bridge project.
- v. Eight roads, including the Lagos-Ibadan Expressway and Igbogbo-Lagos, would be aligned with the Fourth Mainland Bridge.
- vi. The bridge will serve as a complement to the Eko, Carter, and Third Mainland Bridges and help to reduce traffic.
- vii. The bridge, when completed, would become the second longest in Africa with three toll plazas, nine interchanges. The project will also give birth to the longest of all the bridges connecting Lagos Island to the mainland. See Fig.5.

SOURCE: <https://punchng.com/10-things-to-know-about-proposed-fourth-mainland-bridge/>

Diligent and timely completion of the project will, no doubt, boost Nigeria's score card on infrastructure.

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