



**THE FEDERAL UNIVERSITY OF
TECHNOLOGY, AKURE**

**RESOURCE LEVELLING: AN ELIXIR
GUARANTEED TO INDUCE EFFECTIVE
PROJECT DELIVERY**

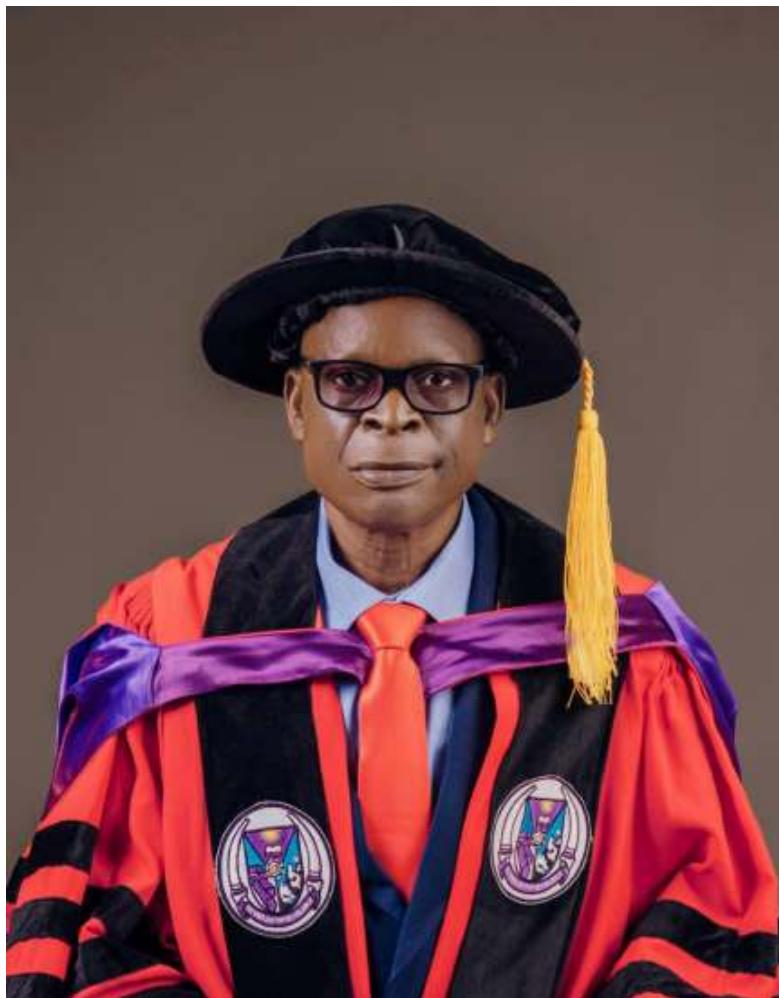
INAUGURAL LECTURE SERIES 204



Delivered by
Prof. Oyewale Julius OJO
CFPM, FIPMD, MIDFPM
B.Sc. (Nsukka), M.Sc., PhD (Ile-Ife)

**PROFESSOR OF CONSTRUCTION PROJECT
MANAGEMENT**

Tuesday, 11th August, 2026



Prof. Oyewale Julius OJO
CFPM, FIPMD, MIDFPM
B.Sc. (Nsukka), M.Sc., PhD (Ile-Ife)

**PROFESSOR OF CONSTRUCTION PROJECT
MANAGEMENT**

RESOURCE LEVELLING: AN ELIXIR GUARANTEED TO INDUCE EFFECTIVE PROJECT DELIVERY

PROTOCOL

The Vice Chancellor
Deputy Vice Chancellor (Academic)
Deputy Vice Chancellor (Development)
The Registrar
Other Principal Officers of the University
Provost, Deans and Directors
Heads of Departments,
Professors and other Members of Senate
Fellow Academics
Members of Administrative and Technical Staff of the
University
His Royal Highnesses
My Lords Spiritual and Temporal
Distinguished Professional Colleagues
Distinguished Guests and Friends of the University
Gentlemen of the Press
Distinguished Ladies and Gentlemen
Great FUTARIANS

PREAMBLE

It is with deep humility and profound gratitude to Almighty God that I am still alive today to stand before you as a Professor of Construction Project Management to deliver the 204th Inaugural Lecture of this great University, The Federal University of Technology, Akure. The 204th Inaugural Lecture titled “**Resource Levelling: An Elixir Guaranteed to Induce Effective Project Delivery**” marks the second in the Department of Project Management Technology and 4th in the School of Logistics and Innovation Technology.

Madam Vice Chancellor, the word ‘elixir’ is a metaphor that connotes a magical or medicinal solution capable of curing persistent problems. In project management, resource levelling functions as such an elixir for restoring workload balance, reducing resource conflicts, avoiding over allocation, and improving project delivery across different sectors.

In a world marked by rapid urbanisation, technological disruptions, and the demand for efficient utilisation of limited resources, the concept of resource levelling emerges as a strategic tool capable of transforming project outcomes.

This lecture seeks to illuminate the theoretical foundations, empirical insights, and practical implications of resource levelling as a critical project management technique. It underscores how the harmonisation of resource allocation, workload balancing, and schedule optimisation can significantly enhance project performance, reduce risks, and ensure sustainable project delivery.

By examining the technique through both academic and real-world lenses, the lecture demonstrates its potential as an “elixir” that is a powerful and dependable mechanism for achieving effective and predictable project delivery.

In line with the University’s commitment to advancing scholarship and promoting evidence-based practices, this inaugural lecture invites stakeholders, academics, practitioners, policymakers, and students to engage in thoughtful and disciplined reflection on how resource management can elevate performance in construction, engineering, and other project-driven environments. It represents a synthesis of years of research, professional experience, and intellectual inquiry, and offers a forward looking perspective on the evolving landscape of project delivery.

INTRODUCTION

1.0 CONCEPTUALISING RESOURCE LEVELLING

In project management, resource allocation, resource scheduling, resource levelling and resource smoothing are closely interrelated concepts used to manage project resources effectively. They perform different functions in planning, executing and controlling project resources. Resource levelling cannot take place without resource allocation and scheduling, also resource levelling is incomplete without resource smoothing; hence the title of my lecture.

1.1 Resource Allocation: is the process of assigning the right types and quantities of resources necessary to complete a project from the beginning to the end. Resource allocation determines who performs a particular task and what he can use to do the work effectively. This assists the project team to know their specific roles in executing the project, also assigns them the resources required to carry out the work by considering their availability, technical know how and competencies.

1.2 Resource Scheduling: is the process of determining when and for how long resources will be used on project activities. It answers the question: "When will the resources be used?" It links resources with the project timeline. This is where the project scheduling tools such as network diagrams and Gantt Charts are applied.

1.3 Resource Levelling: is the technique of adjusting the project schedule to resolve resource conflicts or over-allocation while maintaining efficient resource utilisation. It answers the question: "How can we avoid overloading or underutilising resources?" It ensures balanced resource usage throughout the project lifecycle. Conflicts or imbalances are corrected through resource levelling.

1.4 Resource Smoothing: is a technique that project managers use when time constraints are a higher priority than resources. The goal of this technique is to ensure the completion of a project on time while

taking advantage of when resources are available. Both resource levelling and resource smoothing depend on float (slack). The primary difference between the two is the project constraint that is prioritised. Resource levelling focuses on the availability of resources whereas resource smoothing prioritises time constraints. Therefore, the two work together. In order to deal with limited resource availability and time constraints, there is a need to implement both techniques to optimise the project plan. In practice, in most cases, resource levelling is implemented before resource smoothing.

2.0 RESOURCE LEVELLING IN THE SCRIPTURE

Madam Vice Chancellor, resource levelling happened in the scripture, II Kings, Chapter 6: Verses 1–7; (KJV). When the sons of the prophets wanted to build a bigger accommodation, and they came to tell Prophet Elisha. They went to River Jordan to get beam (wood) for the construction, one of them asked Elisha to go with them (Risk forecasting in project management). One of them had borrowed an axe, and while cutting wood with it, the axe head fell into the water; and he cried and said, "alas master! For it was borrowed." The man of God (Elisha) asked, where fell it? He showed him the place inside water. Elisha cut down a stick, and threw it into the water, causing the heavy iron axe head to float to the surface, cutting of the wood continued, conflict in executing the project was avoided.

Furthermore, the phrase "count the cost before building" is a biblical reference from the Gospel of Luke 14:28–30 (KJV), where Jesus Christ asked, "For which of you, intending to build a tower, does not sit down first and count the cost, whether he has enough to finish it?" It is a metaphor for practical, spiritual, and emotional preparation before making a commitment. Practically, it means to thoroughly evaluate the resources (time, money, materials and machinery) required to complete a project or endeavour to avoid starting a project that cannot be finished. The backbone of every project is the availability of resources. Studies showed that resource misallocation, project taking more time than estimated, reviewing of project materials, among others remain the

persistent causes of project failure (Ojo, et al; 2014; Ojo, 2014; Ojo, 2015b; Ojo, 2016; Ojo, 2018; Ojo et al, 2020; Ojo, 2021). In construction, and other types of project, fluctuating resource demands create conditions where workers experience periods of intense overload followed by idleness, thereby reducing overall productivity. Also, the fluctuating allocation of resources create challenges such as time overrun, leading to cost overrun and reduced workers' morale, unpredictable project schedules, affecting stakeholder confidence. Furthermore, over-utilisation or under utilisation of resources, machinery downtime and wastage, and declining quality due to rushed work during peak resource phases affect the deliverables. Therefore, resource levelling emerged as a response to these challenges.

3.0 WHAT IS A PROJECT?

Madam Vice Chancellor, the term project has a wider meaning. A project is accomplished by performing a set of activities. For example:

- (i) **Construction of a house** involves activities like digging of foundation trenches, casting of foundation concrete, construction of foundation walls, casting of oversite concrete, construction of walls, construction of roof, fixing of doors and windows, fixing of sanitary fittings, wiring, finishing and so on. The construction of a house is accomplished by performing these sets of activities. Others are:
- (ii) Organising marriages for our children
- (iii) Organising burial ceremonies for aged people
- (iv) Organising conferences, workshops and so on.

Another aspect of project is the non routine nature of activities. Each project is unique in the sense that the activities of a project are non routine.

According to the Project Management Institute (PMI)(2025), a project is a temporary endeavour undertaken to create a unique product, service, or result. A project is temporary because it has a clear beginning and a defined end. Also, it involves the planned coordination of resources to deliver a specific facility or system that satisfies technical, economic, and regulatory requirements. A project must be situated within a broad organisational goal.

3.1 The Origin of Projects

Madam Vice Chancellor, the first project was the creation of the Universe by Almighty God. The start date of the project was Day one, while the finish date was Day seven. The activities performed by the Almighty God spanned through seven days (Genesis Chapter 1 to Chapter 2; Verses 1 and 2; King James Version (KJV)).

3.2 Activities/Tasks Performed by Almighty God

Day One: Creation of the heaven and the earth, the evening and the morning.

Day Two: Divisions of waters from waters.

Day Three: Gathering of water under the heaven to one place, leading to appearance of dry land called the earth and the remaining water called the seas; Creation of grass, herb and fruit trees.

Day Four: Creation of lights to divide the day from the night, for signs, seasons, days and years. Creation of two great lights, the greater light to rule the day, the lesser to rule the night, and created stars also.

Day Five: Creation of abundant moving creatures that have life in the water, and fowl that may fly above the earth, great whales, every living creature that moves, which the waters brought forth abundantly, after their kind, every winged fowl after his kind and blessed them.

Day Six: Creation of the living creatures after their kind, and lastly from the day, creation of man to have dominion over every creature which He (God) had created.

Day Seven: God ended His work and rested.

3.3 Humankind Projects

Projects undertaken by humankind are not new. The concept of projects is as old as human civilisation. Historical achievements such as the Egyptian pyramids, constructed around 2650 BC, illustrate the successful execution of complex projects involving planning, organisation, resource allocation, and coordination (Wengrow, 2006). Another wonder of the world is the Taj Mahal project. The period of the construction of Taj Mahal was reported to be during 1626 to 1648 A.D. It was reported that about 20,000 persons worked on the project for nearly 22 years to complete the spectacular structure, which stands today as mankind's

proudest creation (Nagarajan, 2020). The resources and expertise which such a project would consume from start to finish would be magnificent.

4.0 CLASSIFICATION OF PROJECTS

In project management, publications on project classification emphasize that “one size does not fit all”, so focussing on tailoring management approaches to project types based on dimensions like uncertainty, complexity and urgency is necessary. Therefore, projects can be classified in several ways depending on sector, purpose, ownership, size, funding source, and duration. Classification of projects is important because different types of project require different resource levelling approaches to ensure effective project delivery. Furthermore, classification of projects helps in: selecting appropriate project management methodology, determining resource allocation strategies, applying resource levelling techniques, managing risk and stakeholder expectations. Also, several studies suggested various classification frameworks (Steele, 1975; Blake, 1978; Ahitur & Neumann, 1984; Cash et al; 1988; Pearson, 1990; Wheelwright & Clark, 1992) in Dvir et al, (1998).

There is no discipline where project is not being carried out. Here are the projects among others grouped by **sector, purpose, ownership, size, funding source and duration:**

4.1 Classification by Sector

There are many different potential purposes for a system of classification of projects by sector. One of the purposes would be to select the right Project Manager based on the requirements of a specific project (Youker, 1999). These are the projects classified by sector:

4.1.1 Construction Sector:

Effective project management practices are crucial in the construction and engineering sectors, providing a structured approach to planning, executing and controlling projects. They set clear objectives, define

scopes, allocate resources efficiently, and manage risks effectively (Shah et al; 2023).

Projects in construction sector involve physical infrastructure development like, buildings, roads, bridges, dams, airports and so on (Plate 1).



Plate 1: Building, Road and Bridge Construction Projects

4.1.2 Engineering Sector:

Projects in the engineering sector are highly technical and design intensive. The projects are: power plants, manufacturing plants, oil and gas facilities and so on (Plate 2).



Plate 2: Power Generating Plant

4.1.3 Education Sector

Madam Vice Chancellor, the importance of project management in education has become increasingly evident in our evolving technology-ridden lives. Educators are required to manage complex projects involving multiple stakeholders, resources and deadlines. These requirements make project management methods of particular interest to educators looking for practical tools. Therefore, using project management principles, educators can effectively teach and improve their students' learning outcomes. Project management gives students valuable skills, allowing them to succeed personally and professionally (Even, 2024).

Projects in education sector among others include e-learning platform development, school internet connectivity, curricula development, teacher development, inaugural lecture, school feeding, scholarship and bursary schemes, research and development, distribution of textbooks, governance and policy reform [like institutional verification and accreditation exercises by the National University Commission (NUC), Impact and Needs Assessment of TETFund Interventions in Tertiary Institutions Across the Six Geopolitical Zones of Nigeria [(2016-2025)(Plate 3)].



Plate 3: University Library, Computer Lab

4.1.4 Political Sector:

Many initiatives relating to governance are generated by a need for improvement of organisational performance and ability to implement and adapt to change. These generally take the form of projects and programmes encouraging a variety of project management implementations in the public sector (Crawford & Helm, 2009).

Projects in this sector include political/electoral projects like presidential election, local governments election and so on. A country election is managed by a national electoral body (e.g; Independent National Electoral Commission in Nigeria). An election has structured phases as planning, voters' registration, campaigning, voting, collation, and declaration (Plate 4).

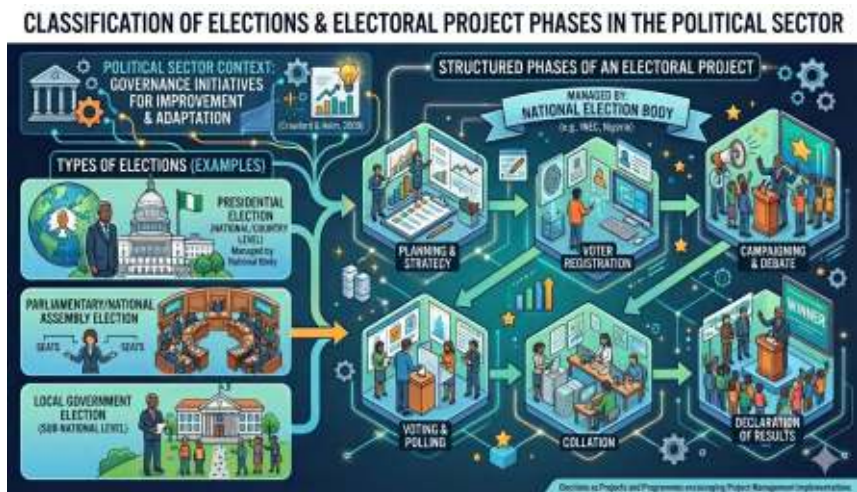


Plate 4: Electoral Project Phases in the Political Sector

4.1.5 Agricultural Sector:

In this sector, effective project planning encompasses resource management, monitoring, and evaluation, which is directly linked to the success and performance of agricultural projects (Tuyiserge & Kabanda, 2023). Projects in agricultural sector involve:

(i) Crop production projects (cereal crop production projects, root and tuber projects, cash crop projects and horticultural projects)(Plate 5)



Plate 5: Crop Production Projects

(ii) Livestock production projects (poultry farming projects, cattle ranching projects, goat and sheep rearing projects, pig farming projects and diary production projects)(Plate 6)



Plate 6: Cattle Ranching Project, Poultry Farming Project, Goat Rearing Project

(iii) Agro-processing projects (rice milling plants, cassava processing – garri, starch and ethanol, oil palm processing mills, and dairy processing plants)(Plate 7)



Plate 7: Cassava Plant, Rice Mill, Dairy Processing Plant

(iv) Research and Development projects (Seed improvement programmes, climate-smart agriculture research and pest and disease control research)(Plate 8).



Plate 8: Pest and Disease Control, Research Center, Climate Smart Agriculture

(v) Agricultural Extension Projects (Farmer training programmes, and cooperative development projects)(Plate 9)



Plate 9: Farmer Training Programmes

4.1.6 Health Sector:

Projects in the health sector are initiatives designed to improve healthcare delivery, public health outcomes, infrastructure, policy implementation, and health systems performance. The implementation of a project management framework facilitated the effective distribution and utilisation of the Human Papillomavirus (HPV) vaccine in independent pharmacies in South Africa through efficient resource allocation, resource assessment, prioritisation of resource allocation and resource monitoring (de Koker, 2023). Also, optimising time and efficiently managing resources is imperative and a thorough understanding of the medical-healthcare environment proves advantageous for conscious and balanced management of aspects such as budget, medical staff, and supplies (Ansaldi et al; 2024) in Finato (2024).

Projects in this sector include:

- i. **Health Information Systems Projects:** These involve digital transformation and data management systems. Examples are Electronic Medical Records (EMR) implementation; Telemedicine platforms; National health database development and Digital disease surveillance systems projects coordinated by Nigeria Centre for Disease Control.

- ii. **Public Health Intervention Projects:** These projects are designed to prevent disease and promote community health. Examples are immunization campaigns, programmes supported by World Health Organisation, malaria control projects like distribution of insecticide bed nets, HIV/AIDS prevention programmes and maternal and child health initiatives.
- iii. **Health Research Projects:** These generate knowledge to improve medical practice and policy. Examples are: epidemiological studies, drug development research and health systems research. In Nigeria, institutions like the National Institute for Medical Research lead many of such projects.
- iv. **Capacity Building and Training Projects:** These projects focus on strengthening human resources for health. Examples are: training of nurses and midwives, continuous professional development programmes, residency training programmes in teaching hospitals and community health worker training initiatives.
- v. **Health Policy and Reform Projects:** These projects aim at improving governance and healthcare financing. Examples are: national health insurance scheme reforms (National Health Insurance Authority), and health financing reform programmes.
- vi. **Medical Equipment Procurement Projects:** These projects are concerned with acquisition and installation of health technologies. Examples are: Magnetic Resonance Imaging (MRI) and Computer Tomography (CT) scan procurement, laboratory equipment modernisation and ambulances upgrade projects.
- vii. **Emergency and Humanitarian Health Projects:** These projects are activated during crises and disasters. Examples are pandemic response projects like Coronavirus disease-19 (COVID-19) response, cholera outbreak control programmes and refugee health support initiatives (Plate 10).

This inaugural lecture focuses on project management and resource levelling, therefore health sector projects are particularly sensitive to skilled manpower allocation, equipment utilisation, budget constraints and time-critical delivery (especially emergency health projects).



Plate 10: Medical Equipment Procurement Project

4.1.7 Logistics and Transport Sector

Project Management and Supply Chain Management are both complementary and necessary for a successful endeavour. Project managers are concerned with logistics-related issues and logistics managers will need to work within a project-based framework (Pich et al, 2002) in Haralke (2023)(Plate 11).

Projects in this sector involve the planning, movement, storage, and distribution of goods, services, and people from one location to another. These projects are critical to economic development, especially in developing economies like Nigeria where infrastructural gaps affect supply chains. Projects in logistics and transportation sector include:

- i. **Transportation Infrastructure Projects:** These focus on developing physical facilities for movement. Examples are road transport projects, rail transport projects, air transport projects, maritime and inland waterway projects.
- ii. **Logistics and Supply Chain Projects:** These projects enhance efficiency in storage, handling and distribution. Examples are

warehouse development projects, fleet management projects, supply chain optimisation projects.

- iii. **Multimodal and Intermodal Transport Projects:** These projects integrate multiple transport modes like rail-sea cargo integration, inland container depots and logistics hubs and free trade zones. Example: Inland Dry Port development linked to seaports.
- iv. **Urban Mobility and Smart Transport Projects:** These projects are intelligent transport systems (ITS), traffic management systems, e-ticketing systems, ride-sharing platforms, integrated mass transit systems and Bus Rapid Transit (BRT). Example: Lagos Metropolitan Area Transport Authority BRT system.
- v. **Policy and Regulatory Projects:** These projects include: national transport master plans, public-private partnership (PPP) transport sector reforms and customs modernisation initiatives.
- vi. **Humanitarian and Emergency Logistics Projects:** These include disaster supply relief supply chains, vaccine distribution logistics and emergency evacuation systems.

The relevance of logistics and transportation projects to project management cannot be overemphasised, from a project management perspective, these projects typically require: critical path method/programme evaluation and review technique (CPM/PERT), resource levelling (especially for equipment and labour), risk analysis, stakeholder management and cost-benefit analysis. In resource levelling, logistics and transportation projects provide excellent case applications, particularly in highway construction scheduling, fleet deployment optimisation, and port expansion programmes in Nigeria and Africa.



Plate 11: Logistics and Supply Chain Projects

4.1.8 Oil and Gas Sector

Projects in this sector are capital-intensive, high-risk, and technologically complex undertakings that span the entire hydrocarbon value chain, that is from exploration to distribution. Oil and gas industry is complex and competitive, so projects in this sector are characterised by their importance and complexity. In order to achieve sustainability, oil and gas firms have to initiate and complete projects to scope, schedule, cost and quality. Therefore in oil and gas, efficient Project Management Methodologies (PMMs) play a crucial role in successful project delivery (Abdulla & Al-Hashimi, 2019). Focusing on project classification and resource optimisation in infrastructure contexts, this sector offers rich case material for studying large-scale project delivery and resource levelling. Therefore, oil and gas projects are typically grouped into Upstream, Midstream, and Downstream categories (Plate 12).

- i. Upstream projects refer to Exploration and Production. These involve locating and extracting crude oil and natural gas. Examples are: offshore drilling projects, like projects in the Niger Delta; Deepwater field development, like Bonga oil field also in Niger Delta, Nigeria, onshore well development, seismic survey projects, and Floating Production Storage and Offloading (FPSO) installation.

- ii. Midstream Projects refer to Transportation and Storage. These involve moving and storing hydrocarbons. Examples are pipeline construction like Trans Niger Pipeline; gas transmission projects, like Nigerian Liquefied Natural Gas (NLNG) Limited gas supply infrastructure; storage terminal development; compressor and pumping stations and Liquefied Natural Gas (LNG) export terminal projects.
- iii. Downstream Projects refer to Refining and Distribution. These involve processing crude oil into usable products and delivering them to consumers. Examples are refinery construction like Dangote Refinery, petrochemicals plants, gas processing plants, depot and tank farm development and retail distribution infrastructure.



Plate 12: Oil and Gas Sector Project

4.2 Classification By Purpose

Some projects are classified by their purpose. These projects are:

- 4.2.1 (a) Capital projects: These are physical assets like buildings, roads and so on.
- 4.2.2 (b) Maintenance projects: Upgrade or rehabilitate existing assets.
- 4.2.3 (c) Expansion projects: Increase capacity or scale of operations.

4.2.4 (d) Transformational projects: Designed to change organisational direction.

4.3 Classification By Ownership

Some projects are classified by their ownership. These projects are:

4.3.1 (a) Public projects: funded and executed by government agencies.

4.3.2 (b) Private projects: owned and financed by private individuals, organisations, and religious bodies.

4.3.3 Public-Private Partnership (PPP): Joint collaboration between government and private sector.

4.4 Classification By Size

Some projects are classified by size. These projects are:

4.4.1 Small-Scale Projects: These are projects with limited budget, short duration, fewer resources.

4.4.2 Medium-Scale Projects: These are moderate complexity projects. They are more structured than small projects but do not require the extensive resources and coordination typical of large-scale projects.

4.4.3 Large-Scale Projects: These projects can also be referred to as megaprojects. High capital intensity, multiple stakeholders and long duration. Examples are Lagos-Ibadan Express Way, Lagos-Sokoto Expressway, Lagos-Calabar Coastal Highway, a major federal project that runs along Nigeria's Atlantic Coastline, Dangote Refinery, Lekki Sea Port and so on.

4.5 Classification By Funding Source

These are internally funded projects (e.g. Internally Generated Revenue (IGR) funded projects), externally funded projects (e.g. World Health Organisation Assisted Programmes; World Bank Assisted Projects) and Donor Funded Projects (e.g. Projects funded by Philanthropists, Alumni and other well-meaning individuals) .

4.6 Classification By Duration

These are short-term projects (≤ 1 year), medium-term projects (1–3 years) and long-term projects (> 3 years).

5.0 WORK BREAKDOWN STRUCTURE

Resource levelling requires a sound knowledge of Work Breakdown Structure (WBS) of each project to be executed. In addition, solid resource management skills and thorough understanding of what each project needs through WBS assist in resource levelling process. According to A Guide to the Project Management Body of Knowledge (PMBOK Guide) Eighth Edition (2025), WBS is a hierarchical decomposition of the total scope of work to be carried out by the project team to accomplish the project objectives and create the required deliverables. This is necessary to ensure an easy progression between tasks to be performed. The WBS is critical because resource allocation begins at the work package level. Network analysis [Critical Path Method (CPM) / Programme Evaluation and Review Technique (PERT)] is derived from WBS and effective resource levelling cannot occur without clearly defined work packages.

An example of network analysis to be explained under the tools and techniques for resource levelling and project delivery.

6.0 TOOLS AND TECHNIQUES FOR RESOURCE LEVELLING AND PROJECT DELIVERY

Project managers use various tools and techniques for levelling the available resources during project execution. These tools show at a glance how resources are allocated, who is overloaded, and who has time to work on other tasks. Presently, modern tools have made levelling more effective. Here are the effective tools and techniques among others project managers should consider while planning resources across projects:

- (i) Network Analysis
- (ii) Critical Path Method (CPM)
- (iii) Programme Evaluation and Review Technique (PERT)
- (iv) Precedence Diagramming Method (PDM)
- (v) Heuristic algorithms

- (vi) BIM/4D scheduling tools
- (vii) AI driven planning systems
- (viii) Work study methods and Lean tools
- (ix) Primavera P6
- (x) DUCAP (Developed by CIPMN)
- (xi) Microsoft Project

These tools improve accuracy and allow project managers to simulate multiple scenarios before selecting the optimal schedule.

Madam Vice Chancellor, network analysis represents a project as a network of interrelated activities showing:

- (i) Logical dependencies
- (ii) Activity durations
- (iii) Critical paths
- (iv) Float (slack) times

Despite the fact that modern tools have replaced old tools in project management, old tools are still a core theoretical and practical tool. A network diagram shows task sequence and dependencies clearly (who depends on what). It helps identify the critical path, delays, and bottlenecks early. CPM/PERT are still in use in construction, engineering and complex infrastructure projects. However, the manual drawing style like in old textbooks is less common in practice nowadays. Hand drawn network diagrams are no longer relied on; they are now embedded inside the software.

Therefore, modern tools automatically generate network logic from inputs like tasks, durations and dependencies. These tools do auto-calculate critical paths, update dependencies instantly, integrate with Gantt charts and dashboards, and also enable real-time collaboration. In practice nowadays, professionals mostly use Gantt charts, Dashboards and software generated schedules. The network diagram is not explicitly drawn but often hidden behind the software engine. Analytical tool is the network diagram, while the operational tool is the software.

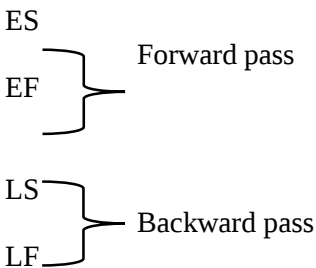
6.1 Application of Network Analysis in Projects

Madam Vice Chancellor, without network analysis, resource levelling is blind and without resource analysis, network schedules are unrealistic. Resources and network analysis are foundational tools in project management used to plan, schedule, control, and optimise project execution. While network analysis focuses on the logical sequencing and timing of project activities, resource application concerns the allocation and utilisation of limited resources like labour, materials, equipment, and finance across those activities.

In practice, effective project delivery emerges from the integration of network logic with resource optimisation, particularly through resource levelling and smoothing.

Figure 1 shows the network of a shopping complex project. Forward pass and backward pass computations are calculated and the critical path is located as shown in the figure with a parallel line symbol.

To find the Critical Path (CP), the earliest start time (ES) and the earliest finished time (EF) should be computed.



The critical path of a network gives the shortest time in which the whole project can be completed. Also, it is the chain of activities with the longest duration times.

$A \rightarrow E \rightarrow F \rightarrow G \rightarrow J$ is the critical path and project duration along the critical path is 26 weeks. The project duration should not exceed the minimum project schedule, that is, project should be completed in 26 weeks' time. In this project, the project completion time is the constraint, therefore, it is a problem of resource levelling.

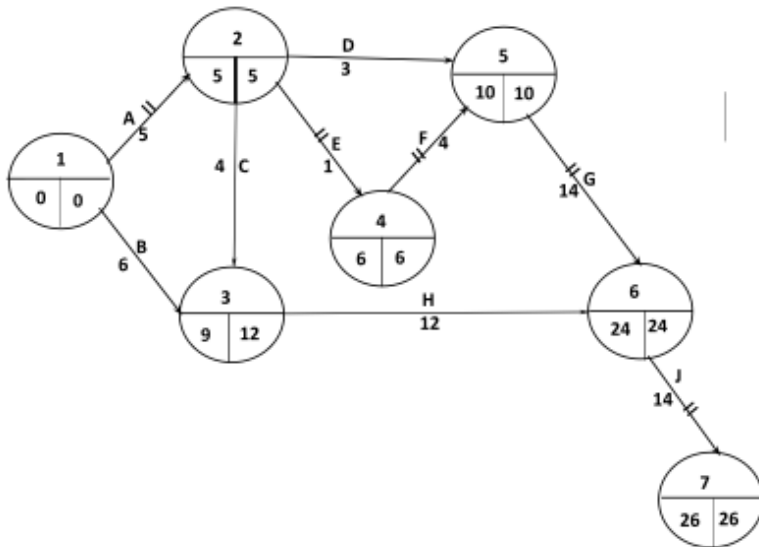


Figure 1: Network Analysis of a shopping complex project

Critical Activities

Critical activities are those which make up the critical path and, of course, connect critical events. Float is associated with activities which are non-critical, activities on the critical path cannot have float.

Table 1 is computed from Figure 1. Activities A, E, F, G, J are the critical activities with zeros (0), while activities B, C, D, H are non-critical activities. **Resource levelling takes place on the non-critical activities using the float.**

Activity B can be delayed for 6 weeks, activity C can be delayed for 3 weeks, activity D can be delayed for 2 weeks, while activity H can be delayed for 3 weeks without affecting the 26 weeks duration of the project from the start date to the finish date. Resource levelling is not limited to manpower alone. In project management, resource levelling can be applied to all categories of project resources whenever there is over-allocation, shortage, or conflict in usage. This is to ensure smooth project execution and efficient resource utilisation.

Activity	LS	LF	ES	EF	Float (Slack) Wks
*A	0	0	0	0	0
B	6	6	0	6	6
C	12	12	9	12	3
D	10	10	8	10	2
*E	6	6	6	6	0
*F	10	10	10	10	0
G	24	24	24	24	0
H	24	24	21	24	3
*J	26	26	26	26	0

7.0 MY CONTRIBUTION TO PROJECT DELIVERY AND KNOWLEDGE

Madam Vice Chancellor, as earlier mentioned, projects cannot be executed without the use of resources. Project delivery requires adequate and availability of resources. The main focus of this lecture is project delivery. Therefore, my research efforts in the past years cut across project planning, execution, monitoring and control, and project delivery. Collectively, these aspects enhance efficiency, reduce delays and cost overruns, improve quality and contribute significantly to successful project delivery. Therefore, in today's lecture, I will like to share my contributions to project delivery and knowledge in two areas: (i) Project Management and, (ii) Construction Project Management.

7.1 Project Management

(i) Project Delivery and Human Capacity Building

Ojo (2014) carried out a study on project delivery and human capacity building as it affects Long Lasting Insecticidal Nets (LLINs). These are specially treated mosquito nets designed to provide long term protection against mosquito bites, particularly mosquitoes that transmit

malaria. These mosquito bed nets are manufactured with insecticide incorporated into or coated around the fibres. The insecticide remains effective for several years without frequent treatment.

Distribution of the nets was a service rendered, an aspect of healthcare projects delivered by the National Primary Health Development Agency (NPHCDA). The beneficiaries according to the programme are **pregnant women, children less than five years of age and farmers (Plate 13)**. The result showed that people outside the stated category benefited from the programme. Also, challenges faced by the project execution team members among others include; possibilities of attending to one person twice or more, provision of mobility for movement, and accessibility to rural areas with mean scores of 2.19, 1.91 and 1.85 were rated low and very low. The resources required for the project were available but the human resource (manpower) lacked competency training in project management. This led to misallocation of the product (mosquito nets), that is improper, inefficient and inappropriate distribution of the nets. This resulted in misapplication of the resources by the citizenry like the use of the nets for packaging waste products (empty water and soft drinks plastic bottles), fencing, fishing among others (Plates 14, 15). The health workers need capacity training in project management.



Plate 13: Long Lasting Insecticidal Net (LLIN)



Plate 14: Net used for packaging waste products



Plate 15: Net used for packaging and transporting waste products



Plate 16: Net used for fencing

(ii) Business Environment and Sawmill Project Investment (Forest Product Management)

In a sawmill project investment, resource levelling is important in several ways like, efficient utilisation of machinery, labour optimisation, financial resource management, project schedule stability and risk reduction among others.

Ojo (2015a) examined the impact of business environment on sawmill project investment in Osun State, Nigeria. There were 278 sawmill firms located in the study area, out of which 14 were no more in operation. The descriptive statistical tools were used to analyse the data collected. The study revealed that new entrants in lumber production (conversion of logs in the forest by the chainsaw machine operators) (4.18), high cost of production (4.17), reduction in supply of logs (4.17), down time (4.16) were the factors responsible for the changes in sawmill industry's business environment in the study area. The study concluded that entrepreneurs did not have interest in embarking on the investment any more due to the challenges facing them as a result of resource levelling deficiency.

(iii) Information and Communication Technology (ICT) Management and Customer Service Delivery

Madam Vice Chancellor, in a bid to catch up with global development, improve the quality of customer service delivery and reduce transaction cost, banks have invested heavily in ICT, and have widely adopted ICT networks for delivering a wide range of value added products and services (Aliyu & Tasmin, 2012). Based on that context, Ojo and Kolawale (2016) carried out a study on Information and Communication Technology Management and customer service delivery in the Nigerian banking industry. The rapid changes resulting from innovations, technological breakthroughs, increased awareness and demands from customers, make business organisations operate in a complex environment. The study examined how ICT had enhanced efficiency in customer service delivery and identified the challenges facing the use of ICT in the banking industry. The study was carried out in Ondo State, Nigeria. The regional headquarters of the selected banks within Akure metropolis were adopted for the survey, in view of the fact that the headquarters of each of the branches coordinates the activities of the other branches in the state. The banks were carefully selected based on the geographical spread in Nigeria, period of

existence and shares of customers' base in the Nigerian banking industry.

The study was analysed using both descriptive and inferential statistical tools. The results showed that the Analysis of Variance (ANOVA) and Duncan Multiple Regression Test (DMRT) revealed that there was a significant difference ($P < 0.05$) in the perceived ICT efficiency in customer service delivery in the banking industry (Table 2). Also the challenges facing the banking industry in the study area in the use of ICT (Table 3) among others include: unreliable network connectivity (3.67), poor or lack of technological infrastructure (3.48), lack of adequate manpower (3.42), Customers' doubt of ICT related banking services due to insecurity (3.41), high cost of installation and maintenance (3.40) and Cybercrime problems related to ICT (3.27). These challenges are inhibiting internet banking in Nigeria.

Table 2: ICT Efficiency in Customer Delivery in the Banking Industry

S/N	ICT Efficiency	ANOVA	DMRT (sig.)	Decision
i	Efficiency in operation	0.906	0.030	Significant
ii	Improvement in product/service quality	0.002	0.011	Significant
iii	Introduction of new features in products/services	0.263	0.070	Not Significant
iv	Customer service improvement	0.198	0.021	Significant
v	Cost Reduction	0.183	0.245	Not Significant
vi	Ease of free flow of information	0.995	0.037	Significant
vii	Complex operations/processes made simple	0.108	0.022	Significant
viii	Multi-tasking made possible	0.120	0.015	Significant

Table 3: Challenges facing the use of ICT in Banking Industry

S/N	Challenges	Options				F	Σfx	$\bar{X}$	Decision
		SA	A	D	SD				
		4	3	2	1				
i	High cost of installation and maintenance	37	56	0	0	93	316	3.40	Agree
ii	Customers in doubt of ICT related banking services due to insecurity	38	55	0	0	93	317	3.41	Agree
iii	Cybercrime problems related to ICT	34	59	0	0	93	313	3.37	Agree
iv	Unreliable network connectivity	62	31	0	0	93	341	3.67	Agree
v	Poor or lack of technological infrastructure	45	48	0	0	93	324	3.48	Agree
vi	Lack of adequate manpower	39	54	0	0	93	318	3.42	Agree

(iv) USAID Maximizing Agricultural Revenue and Key Enterprises in Targeted Sites (MARKETS) II Project on Cocoa Production

In another study, Ogunjobi, Ojo, Oseni, and Adebambo (2020) assessed the Effect of USAID Maximizing Agricultural Revenue and Key Enterprises in Targeted Sites (MARKETS) II Project on Cocoa Production in Ondo State, Nigeria. The United States Agency for International Development (USAID), Maximizing Agricultural Revenue and Key Enterprises in Targeted Sites (MARKETS) Project is an example of agricultural projects that are crucial to economic growth.

MARKETS II was launched in April 2012 to promote suitable agriculture development via increasing private sector participation and investment, raising income, increasing employment, attaining food security and reducing poverty (USAID, 2017). Multistage Sampling Procedure was used to select a sample size of 154 Cocoa farmers in the study area. Data was collected through the use of structured questionnaires and it was analysed using descriptive and inferential statistical tools (Cobb Douglas Production Function). The result showed that the f- values of the models were highly significant 53.099 and 38.406 before and after the MARKETS II project respectively

(Table 4). Also, the estimated R^2 of 0.839 and 0.791 showed that 83.9% variation in Cocoa output before the project was explained by the independent Variables, while 79.1% Variation was explained by the independent Variables after the project. In addition the Coefficients of seedling (0.143**), harvesting (0.209**) and pesticides (0.174***) had a stronger effect on Cocoa output after the project. The MARKETS II project played a significant role in increasing cocoa production in Ondo State.

Madam Vice Chancellor, from a project management perspective or standpoint, **Cocoa farm establishment and rehabilitation** are agricultural projects that require **resource planning, resource allocation, resource scheduling and resource levelling** to ensure efficient utilisation of labour, materials, equipment, time and funds. Proper management of these resources improves productivity, reduces costs and enhances the success of cocoa development programmes. Therefore, both activities (establishment and rehabilitation) are resource intensive and depend heavily on the effective management of human, material, financial, equipment, land and time resources.

Table 4: Result of regression analysis (Cobb Douglas Production Function)

Before MARKETS II					After MARKETS II			
Code	Variables	Coefficient	t-value	p-value	Variables	Coefficient	t-value	p-value
		3.071	9.047	0.000		3.413	8.811	0.000
Log X_1	Cost of seedling	0.122**	2.056	0.044	Cost of seedling	0.143**	2.046	0.045
Log X_2	Cost of land preparation	0.085	1.506	0.137	Cost of land preparation	0.067	0.828	0.411
Log X_3	Cost of harvesting	-0.001	-0.016	0.987	Cost of harvesting	0.209**	2.100	0.040
Log X_4	Cost of pesticides	0.087*	1.816	0.074	Cost of pesticides	0.174**	3.046	0.003
Log X_5	Cost of labour	0.238***	6.385	0.000	Cost of labour	0.223***	5.221	0.000
Log X_6	Amount of credit	0.240***	2.935	0.005	Amount of credit	0.058***	0.791	0.432
R Square		0.839				0.791		
Adjusted R Square		0.823				0.770		
F - Statistic		53.089				38.406		
Prob F		0.000				0.000		

(v) Gully Erosion Control and Environmental Development

The potential impacts of gully erosion over Southeast Nigeria are a worrisome scenario. It has resulted in the displacement of millions of habitats, agricultural and economic losses. Therefore, my research team, Oyati, Lawal and Ojo (2021) assessed Nigerian Erosion Watershed Management Project (NEWMAP) effects on gully erosion control and environmental development in Southeast, Nigeria. Gully erosion contributes to environmental problems and causes damage estimated at over \$100 million annually in most parts of Nigeria (NEWMAP, 2018)(Plate 16).



Plate 16: Gully erosion

The study developed five (5) sub-hypotheses for **economic development** and five (5) sub-hypotheses for **social development**. The results of the test of hypotheses for the economic development, the standard path coefficients (β), standard error, t-value and the decision in the study (Table 5) showed that three (3) among the five hypotheses on NEWMAP showed evidences of significant effect on economic development of Southeast, Nigeria. Also, for & social development, four (4) among the five hypotheses on NEWMAP showed evidence of significant effect on social development of Southeast Nigeria (Table 6). The findings indicate that NEWMAP administration, communication, implementation or execution, and planning and identification influences the social development of the Southeast, Nigeria. However, monitoring and evaluation of

NEWMAP does not influence the social development of the region. These findings imply that an increase in NEWMAP planning, administration, communication and implementation would improve social development of Southeast Nigeria.

Madam Vice Chancellor, in project management, resources for gully erosion control include human, financial, material, technological, and institutional inputs. These are required to prevent, manage, and rehabilitate areas affected by gully erosion while promoting sustainable environmental development. The successful control of gully erosion depends on the coordinated use of the resources. Therefore, resource levelling is highly relevant to gully erosion control because it promotes the optimal use of labour, equipment, materials and funds.

Table 5: Effect of NEWMAP of Economic Development

Hypotheses	Path Relationship	Beta (β)	T Statistics	P Values	Decision
H _{1a}	NPP1 -> ED	0.0061	0.0817	0.9349	Not-Significant
H _{1b}	NPA -> ED	0.2083	2.9145	0.0036	Significant
H _{1c}	NPC -> ED	0.2647	4.3362	0.000	Significant
H _{1d}	NP1E -> ED	-0.0695	0.9253	0.3548	Not-Significant
H _{1e}	NPME -> ED	0.1718	1.9984	0.0457	Significant

Table 6: Effect of NEWMAP on social development

Hypotheses	Path Relationship	Beta (β)	T Statistics	P Values	Decision
H _{2a}	NPA -> SD	0.265	2.493	0.013	Significant
H _{2b}	NPC -> SD	0.243	2.145	0.032	Significant
H _{2c}	NP1E -> SD	0.225	2.9086	0.0036	Significant
H _{2d}	NPME -> SD	0.1001	1.0868	0.2772	Not-Significant
H _{2e}	NPP1 -> SD	0.1581	2.26	0.0239	Significant

NPPI — NEWMAP Planning and Identification

NPA — NEWMAP Administration

NPC — NEWMAP Communication

NPIE — NEWMAP Implementation and Evaluation

NPME — NEWMAP Monitoring and Evaluation

ED — Economic Development

SD — Social Development

(vi) Community Participation and Social Development Projects

Globally, Community participation is one of the key ingredients of an empowered Community which entails active citizen involvement in all aspects of strategic plan, development and Implementation of projects (IGI Global, 2018). Community participation is a Rurism Strategy which starts with the people, a coherent value system in which human and material resources are mobilised and allocated from the lower echelon of economic and social strata to the top (Samuel, 2015). Based on the above view, Fasuyi, Ojo and Lawal (2022) evaluated the potential effect of community participation on Community and Social Development projects (CSDP) in Southwest Nigeria. The predictive influence of the effect of community participation on CSDP implementation was tested using ordinary Least Square Regression Analysis. The independent or exogenous Variables (community participation in project initiation, planning, execution implementation as well as monitoring and evaluation) were regressed on the dependent variables or endogenous Variables CSDP implementation. The result of the regression model (Table 7) showed a significant

outcome ($F = 59.326$; $P < 0.05$); which means that the exogenous variables had a significant effect on CSDP Implementation. Also, the predictor Variables accounted for 28% ($R^2 = 0.275$) to the Variance in the endogenous Variable (CSDP implementation). Also, the individual effect of Community participation in each of the project life cycle that significantly contributed to CSDP implementation with an estimate $\beta_1 = 0.525$, $\beta_2 = 0.243$, and $\beta_3 = 0.276$ respectively and $P < 0.05$ while with an estimate of $\beta_4 = 0.047$ and $P > 0.05$ in monitoring and evaluation was not significant to CSDP implementation in the study area.

Table 7: Model Summary of the Effect of Community Participation on CSDP Implementation in South West Nigeria

Model	Sum of Squares	Df	Mean Square	F	Significance
Regression	7538.099	4	1884.525	59.326	0.000
Residual	19916.962	627	31.765		
Total	27455.062	631			
		Unstandardised Coefficients		T	Significance
R=.524a, R2 =.275, Adjusted R2 =.270, Standard Error of the Estimate = 5.63609	B	Standard Error	Beta		
(Constant)	17.363	1.556		11.155	0.000
Project initiation	0.525	0.068	0.321	7.674	0.000
Project Planning	0.243	0.101	0.128	2.418	0.016
Execution	0.276	0.097	0.145	2.846	0.005
Monitoring	0.047	0.110	0.021	0.430	0.667

Indicate significance F at $\alpha = 0.05$

(vii) Still on community development projects, further study conducted by my research team, Iloyanomon, Adepoju, Ojo and Aladejebi (2023) examined factors influencing community participation in State Employment and Expenditure for Results Projects (SEEFOR) in Niger

Delta, Nigeria. It was a development project that operated in parts of Nigeria with support from the World Bank to improve employment opportunities and public expenditure management.

The study was assessed with inferential statistics using Partial Least Square in Structural Equation Modelling. The result revealed the factors influencing community participation in SEEFOR projects in the study area as ‘adequate information and relevance of project’ as well as ‘sense of ownership’ showed positive and significant relationship with path coefficients: CINFREL -> BCP (B=0.482, t=12.636) and CSEN -> BCP (B=0.451, t=16.157) (Figure 3, Table 8). The study concluded that adequate information and relevance of project as well as sense of ownership are the major factors influencing community participation in SEEFOR projects in Niger Delta with sense of ownership having the highest

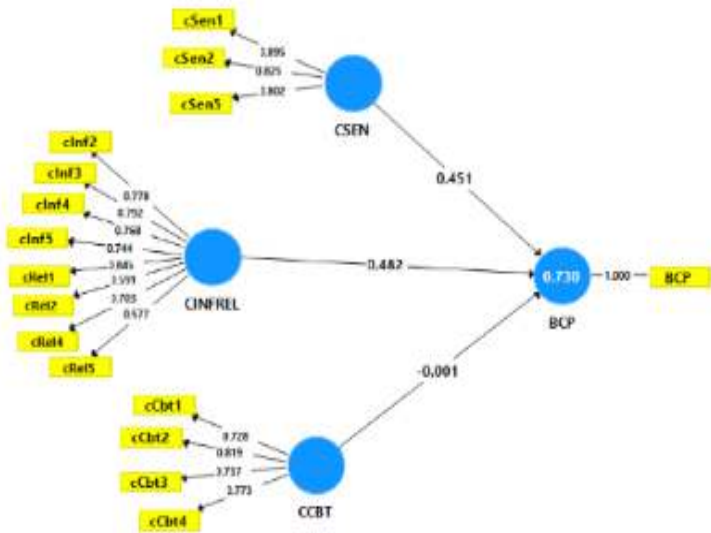


Figure 3: Structural Model for Factors Influencing Community Participation (Algorithm)

Table 8: Path Coefficient

	Original Sample (O)	Standard Deviation	T Statistics	P Values	Bias	2.50%	97.50%	f square	VIF
CCBT -> BCP	-0.001	0.034	0.024	0.981	0.002	-0.069	0.063	0.000	1.796
CINFREL -> BCP	0.482	0.038	12.636	0.000	0.000	0.402	0.553	0.323	2.664
CSEN -> BCP	0.451	0.028	16.157	0.000	-0.001	0.398	0.507	0.406	1.858
R Square	0.730								
R Square Adjusted	0.728								

cSen (Sense of ownership)
ClnfRel (Adequate information and relevance of projects)
cCbt (Capacity building and training)
bCP (Community Participation)

7.2 Construction Project Management

(i) Public Project Execution and Control

In a study carried out by Ojo and Lawal (2014), the study assessed the problems affecting public projects execution and control in Southwest, Nigeria. The scope of the study was limited to both federal and state universities in the Southwest. During the period of the study, there were 155 buildings under construction in the study area. For the purpose of this study, a purposive sampling method was used for the tertiary institution projects. Descriptive statistical tools (percentage, means and Standard Deviation) were used to analyse the study. The result showed the dominant factors affecting the execution and control of public projects among others are; projects taking more time than estimated time (4.83) and reviewing of project materials during project execution (4.22) were rated high. The implication was that project supervisors lack or neglect the idea of resource levelling during project execution. The study concluded that project planning techniques should be well stated before the project execution stage.

(ii) Network Analysis Application to Project Management

In another study, Ojo and Obembe (2014), evaluated network analysis applications to project management in Southwest Nigeria. The scope of coverage of the study was limited to large value projects of one billion naira and above in 2014. The study was based on the techniques like Programme Evaluation and Review Technique (PERT), Critical Path Method (CPM) and Precedence Network Analysis (PNA)

Madam Vice Chancellor, as earlier mentioned, these three techniques have common features of using the network model for depicting the time plan of the project, determining project duration; identifying critical activities and; controlling the project time objectives. The study revealed that the use of Gantt Chart/Bar Chart was 47.3%, PERT, CPM and PNA were 23.3%, while Project Management Software was 3.1% meaning that the techniques were rarely used tools and techniques by Project Managers and Supervisors during the period of the study in 2014. In Nigeria, some building and road projects take longer time before completion due to lack of or inadequate application of those tools and techniques which resource levelling depends on.

(iii) Procurement of Construction Materials

The relationship between public procurement and resource levelling cannot be overemphasised. In public construction projects, procurement determines what resources are available and when they become available, while resource levelling determines how and when those resources are utilised. The two improve project efficiency, reduce waste, minimise delays and enhance successful project delivery. On that note Ojo and Yusuf (2016) assessed the implementation of public procurement reform in Oyo State, Nigeria. Both descriptive and inferential statistical tools were used to analyse the data collected. The result revealed that the null hypothesis that public procurement system was not adequately implemented could not be rejected at 0.05 level of significance. Table 9. The study concluded that none of the aspects of the public procurement system was considered to be adequately implemented.

Table 9: Evaluation of implementation of public procurement system

Descriptive Statistics	Value	Inferential Statistics			
		Univariate	Value	Multivariate	Value
Number of items	70	Number of items	70	No of Variables	20
Mean	2.0	Mean	2.0	Alpha	0.960
Standard Error of Mean	0.133	t-statistics	-7.494	Mean	2.829
Standard Deviation	1.116	Test value	3.00	Variance	0.044
Skewness	0.579	Df	69	Df ₁	19
Standard Error of Skewness	0.287	Mean Difference	-1.000	Df ₂	51
Kurtosis	-1.161	Significant level	0.000	Hotellind's T ²	104.110
Standard Error of Kurtosis	0.566	Confidence Interval	95%	Significance	0.000
		t-critical	-0.73	F-Value	4.050

(iv) In a study conducted by my team, (Lawal, Ojo, Adeosun & Odeyomi, 2016) assessed the effect of project success delay factors on real estate development in Osun State, Nigeria. The scope of coverage of the study was limited to private individual developers. The respondents' perspective in the project success delay factors that affected the performance of real estate were measured on a 5 point rating scale. The result showed the perceived project success delay factors that affected the performance of real estate projects in the study area (Table 10). In the table all the delay factors were rated moderately, which means that all the project's success delay factors affected the performance of real estate projects in the study area. Non availability of quality and sufficient building materials (3.7), poor monitoring and control of projects (3.7) and non use of project management software (3.5) are resource dependency.

Table 10: Project Success-Delay Factors that affected the Performance of Real Estate Projects in Osun State

Delay Factors	Mean Rating
Inadequate funding leading to non payment of completed works	3.9 ^a
Non availability of quality and sufficient building materials	3.7 ^b
Poor monitoring and control of projects	3.7 ^b
Non application of safety procedure and precautions	3.5 ^c
Non use of project software	3.5 ^c
Lack of motivation of project team members	3.5 ^c
Poor communication among the project team members	3.4 ^d
Improper handling of conflicts and disputes	3.2 ^e
Slow decision making process by the client	3.2 ^e
Change of design by the client	3.1 ^f

(v) In a related study carried out by the team, Lawal, Ojo, Odeyomi and Adeosun (2016) assessed project quality management processes adopted by the building project contractors in Osun State, Nigeria. The scope of coverage of the study was limited to medium sized projects belonging to both public and private individuals in the study area. The data collected was analysed using both descriptive and inferential statistical tools (frequency, percentage, mean and one way Analysis of Variance). Table 11 showed the challenges encountered by the contractors which affected the project quality during project execution in the study area. Unavailability of standard materials (2.93) and inadequate facilities, machines, and tools and equipment for effective work on site (2.72) deterred the application of resource levelling in the study area.

Table 11: Challenges Encountered by Contractors during Project Execution

Challenges	Mean Rating
Lack of recognition	3.23
Delay of valuation payment	3.13
Unavailability of standard materials	2.93
Inadequate training and on the job training of workers	2.81
Inadequate number of qualified technicians to carryout the site work	2.78
Inadequate information and communication among stakeholders	2.73
Inadequate facilities, machines, tools and equipment for effective work on site	2.72
Scarcity of skilled workers(artisans)	2.58
Lack of employee commitment	2.57

(vi) Construction Manpower Planning in Project Execution

Ojo, Iloyamonon and Adelusi (2018) assessed construction manpower planning in project execution in Akure, Ondo State, Nigeria. Construction manpower planning is necessary to ensure proper utilisation of human and material resources to achieve the goals and objectives of a project. One of the objectives of the study was the examination of factors affecting construction labour productivity in the study area. Both descriptive and inferential statistical tools (Relative Importance Index, ANOVA, ANOVA, Duncan Multiple Range Test (DMRT) were used for the study. Table 12 showed the perceived factors affecting labour productivity in the study area. One way Analysis of Variance (ANOVA) and Duncan Multiple Range Test (DMRT) were used to determine the level of significance of each of the factors affecting labour productivity. DMRT values based on the opinions of the respondents vary from 0.001 to 0.14, meaning that they have different perceptions on the significance of the factors affecting

labour productivity. As revealed by the table, the dominant factors among others that affect labour productivity are; **reassignment of manpower (0.03), and alternating, staggered, or rotating work schedules (0.009)**. These two factors are the attributes of resource Levelling. Manpower reassignment means moving employees from one assignment to another to achieve better productivity and project performance. It improves resource utilisation, reduces idle time and helps meet project deadlines.

Table 12: Factors Affecting Productivity

Factors	MDMRT (Sig.)	ANOVA	Decision
Morale and attitude	0.01	5.23	Significant
Absenteeism and turnover	0.005	1.25	Significant
Mobilize/Demobilize	0.02	0.912	Significant
Errors and omissions	0.012	5.44	Significant
Start/Stop	0.001	1.87	Significant
Reassignment of Manpower	0.03	3.24	Significant
Crew size Inefficiency	0.03	7.25	Significant
Ripple Effect	0.05	4.11	Significant
Hazardous Work Area	0.01	2.01	Significant
Tool and Equipment Storage	0.002	1.77	Significant
Alternating, Staggered, or Relating Work Schedules	0.009	0.87	Significant
Site Access	0.092	1.59	Not Significant
Logistics	1.08	8.11	Not Significant
Dilution of Supervision	0.12	1	Not Significant
Holidays	0.14	0.71	Not Significant
Weather and Season Changes	0.08	2.05	Not Significant

(vii) Risks Associated with Real Estate Project Delivery

Odeyomi, Lawal, Ojo and Adeosun (2023) assessed risks associated with real estate project delivery in Southwest Nigeria. The study adopted multi-Stage Sampling design among the professionals in Estate Surveying and Valuation Firms registered by the Nigerian Institution of Estate Surveyors and Valuers in Southwest Nigeria. Both descriptive and inferential statistical tools were used to analyse the data collected. Table 13 showed the risks associated with real estate projects delivery in the study area. The result showed that project completion time risk (3.57), project cost risk (3.56) and change order risk (3.48) were ranked 2nd, 3rd and 4th as the risks associated with real estate projects delivery in Southwest Nigeria. The result was due to lack of application of resource levelling by the project supervisors. The study concluded that adequate consideration should be given to project completion time, the cost of the project and change order so as to achieve successful real estate project delivery in the study area.

Table 13: Risks Associated with Real Estate Projects Delivery in Southwestern Nigeria

S/N	Variables	Rating					NR	SWV	MWV	Rank
		5	4	3	2	1	(f)			
1	Inflation Risk	180	468	228	148	76	379	1479	3.90	1
2	Environmental Risk	315	484	306	144	19	377	1268	3.36	9
3	Market Risk	305	464	333	136	18	374	1256	3.35	8
4	Regulatory Risk	315	476	324	136	20	378	1271	3.36	9
5	Financial Risk	280	604	297	98	19	374	1298	3.47	5
6	Construction Risk	325	516	342	110	14	377	1307	3.46	6
7	Project Quality Risk	265	596	312	114	11	374	1288	3.44	7
8	Change Order Risk	380	476	327	92	23	373	1298	3.48	4
9	Project Cost Risk	395	532	276	106	14	371	1323	3.56	3
10	Project Completion Time Risk	305	660	282	94	11	378	1352	3.57	2
									35.04	

Mean of $\Sigma = 35.04/10 = 3.50$

(viii) Assessment of Materials Management Techniques and Inventory Control System on Public Building Projects Delivery.

Ashaolu, Ojo, Ajayi and Sunday (2024) assessed materials management techniques and inventory control system on public building projects delivery in Southeast, Nigeria. The study adopted descriptive research survey design. The population of the study comprise contractors, suppliers, consultants and clients handling building projects in the study area. Both descriptive and inferential

statistical tools were used to analyse the study. The study hypothesis Ho: Materials management practices do not have significant effect on building construction projects delivery in the study area was tested. Table 14 showed the path analysis on materials management technique and building projects delivery. Also, Figure 4 showed the structural model on effect of materials management practices and building projects delivery. The result showed that materials management practices had positive and significant effect on building projects delivery with a path coefficient of 0.635 and P-Value 0.000. Hence, the null hypothesis was rejected. This meant that materials management practices had significant effect on building projects delivery in the study area. The study concluded that materials management practices are highly effective in enhancing building project delivery in the study area.

Table 14: Path Analysis on materials management technique and building projects delivery

H01	Original Sample	Sample mean	Std. Dev.	T-Statistic	P-values	Decision
Material management technique <- building projects delivery	0.635	0.630	0.121	5.258	0.000	Rejected

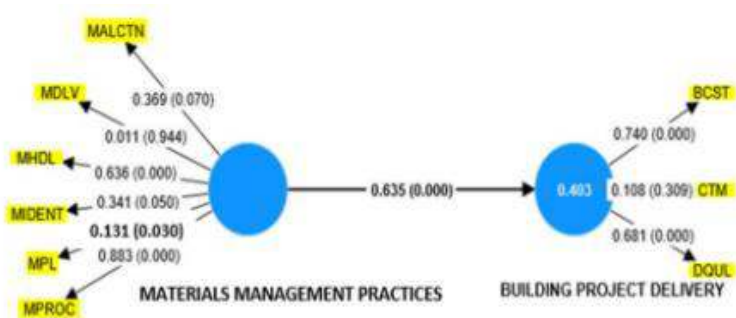


Figure 4: Structural Model on effect of materials management practices and building projects delivery

(ix) Concession Practices and the Cost of Road Projects Delivery

Aladare, Ojo, Abayomi and Aladejebi (2025) examined concession practices and the cost of road projects delivery in Southwest Nigeria. The study employed a survey research design to collect quantitative data from stakeholders involved in road infrastructure projects within the study area. Inferential statistics used involved Partial Least Squares Structural Equation Modelling (PLS-SEM). The concession practices in this study were examined in terms of responsibility development, maintenance activities, finance options and concession operations on the cost of road project delivery in the study area. The impact of finance options on the cost of road project delivery in the study area were measured by public (government), private, project-based, multilateral and alternative financing. Figure 5 and Table 15 showed a positive association in each of the financing options with cost of road project delivery. However, these association were extremely weak especially for private financing (0.00), multilateral (0.02) and alternative financing (0.01) with cost of road project delivery. Meanwhile, the predictive power of these explanatory variables was moderately strong, posting a R-square of around 0.54. This is an indication that 54% of variation in the cost of road project delivery was predicted by the financing options identified in the study.

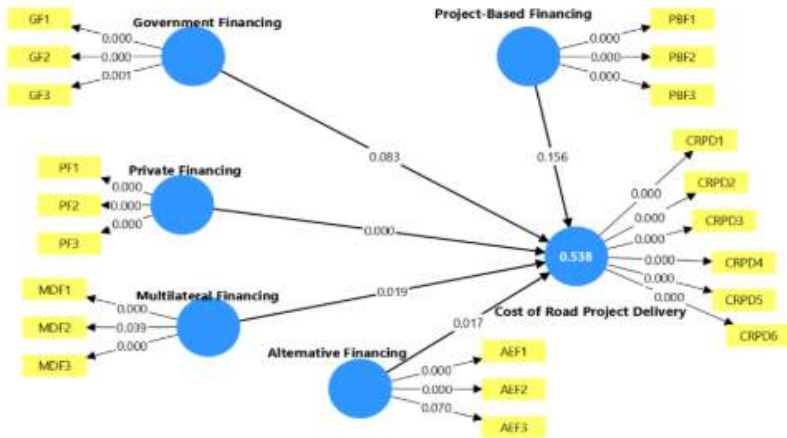


Figure5: Effect of financing options on Cost of Road Project Delivery

Table 15: Path Coefficients Bootstrapping showing the effect of financing options on Cost of road project delivery

Latent	Variables Coeff.	Std. Error	T statistics	P values
Alternative Financing -> Cost of Road Project Delivery	-0.17	0.07	-2.38	0.02
Government Financing -> Cost of Road Project Delivery	-0.13	0.08	-1.73	0.08
Multilateral Financing -> Cost of Road Project Delivery	-0.14	0.06	-2.35	0.02
Private Financing -> Cost of Road Project Delivery	-0.28	0.07	-3.83	0.00
Project-Based Financing -> Cost of Road Project Delivery	0.11	0.07	1.42	0.16
R-square	0.54			0.00
R-square adjusted	0.53			0.00

8.0 CONCLUSION

Madam Vice Chancellor, distinguished guests, students, friends, ladies and gentlemen, it is clear that today's inaugural lecture has established that resource levelling is not merely a scheduling technique but a strategic imperative for effective project delivery. Moreover when resource levelling is properly understood and applied, it is an elixir for

project delivery, especially in environments marked by resource constraints, uncertainty and complexity.

Resource levelling offers a pathway from resource chaos to structured efficiency; from unpredictable delays to reliable project delivery; from overworked staff and idle equipment to balanced workloads and optimal utilisation.

As I conclude this inaugural lecture, I reaffirm my commitment to advancing scholarship and practice in project management and construction project management, not only through teaching and research, but also through policy advocacy, professional engagements and capacity building. I invite stakeholders, academics, practitioners, policy makers and students to embrace resource levelling as a foundational element for responsible, effective project delivery. Let us build a future where projects are not merely initiated but completed with discipline, foresight, fairness and sustainability.

9.0 RECOMMENDATIONS

Based on the foregoing, I will like to suggest the following recommendations:

9.1 Government, Policy Makers and Regulatory Bodies

- (i) Enforce planning standards that require resource scheduling and levelling as part of project approval and monitoring.
- (ii) Contractors should be required to submit resource calendar and resource allocation plans before funding or contract approval.
- (iii) There should be competency training and capacity building for project planning and scheduling professionals.

9.2 Practitioners and Construction Firms

- (i) Modern project management softwares like DUCAP, MS Project, Primavera and so on or resource management tools to support resource levelling should be adopted.
- (ii) For complex projects or multiple concurrent projects, algorithmic or optimisation based scheduling approaches should be considered.
- (iii) Internal protocols for resource levelling and monitoring should be developed, making them standard practice rather than optional.

9.3 Education, Academia and Professional Bodies

- (i) Resource levelling, resource constrained scheduling, and modern resource management techniques should be integrated into project management curricula.
- (ii) Research and empirical studies on resource levelling impacts in developing country contexts, with local data, case studies and context specific adaptations should be encouraged.
- (iii) Above all, the training content of the academic programme should reflect the actual operations, tasks and processes of the occupation.
- (iv) There should be provision for adequate resources, equipment and facilities similar to those used in industry; similar not the same.

ACKNOWLEDGEMENTS

Madam Vice Chancellor, my profound gratitude goes to Almighty God for the gift of life, good health and the grace to reach this pinnacle of my academic career. To God be all the glory for how far He has helped me in life.

I owe a debt of immense gratitude to the incumbent Vice Chancellor, Professor Adenike Temidayo Oladiji FAS, the 1st female and 10th Substantive Vice Chancellor of The Federal University of Technology, Akure. Thank you so much for the privilege to represent "APD Associates Limited, Abuja; on "Impact and Needs Assessment of TETFund Interventions in Tertiary Institutions across the Six Geopolitical Zones of Nigeria (2016 – 2025) as the Team Lead for Southwest Geopolitical Zone. Heavenly Father will continue to lift you up, Amen.

I extend my profound gratitude to all past and present Principal Officers, whose leadership, Vision and steadfast commitment to academic excellence continue to strengthen the foundation upon which scholars stand.

I deeply appreciate the School of Management Technology (SMAT) now School of Logistics and Innovation Technology (SLIT), its past Deans (Prof. Zacheus Opafunso, Prof. Enos Okoko, Prof. Tomola Marshal Obamuyi (New Vice Chancellor, Adekunle Ajasin University, Akungba), Prof. Akinloye Fatai Lawal and the incumbent Dean Prof. Olayemi O. Simon-Oke, other Professors, and Colleagues, for fostering an environment where scholarship thrives and ideas are nurtured.

My deepest appreciation goes to the Department of Project Management Technology, my base and academic home, and to my Senior Prof. A. F. Lawal and colleagues: Prof. (Mrs) M. O. Ajayi, Prof. A. O. Jesu-leye, Dr. O. A. Adepoju, Dr. D. P. Ologunwa, Dr. V. O. Ogunjobi, Dr. A. A. Omonori, Dr. K. T. Alade, Mr. Sunday O. G., Mr. K. J. Ekundayo, Dr. H. O. Adelambo, Dr. (Mrs) O. T. Akinbogun, and Dr. O. A. Aladejebi, Mrs. H. T. Ajibola and Miss J. O. Ologun whose wisdom have improved the academic excellence of the Department.

I greatly acknowledge all my past and present undergraduate and postgraduate students, all of you are wonderful, you have really contributed immensely to my success story. Permit me for not mentioning all your names here, I duly acknowledge you all.

To my esteemed professional bodies, especially Chartered Institute of Project Managers of Nigeria (CIPMN), I thank all the council members for your continuous collaboration and intellectual stimulation. I also like to acknowledge the dedicated National Team of TETFund on Impact and Needs Assessment of TETFund Interventions, and specially acknowledge our Southwest group, which I have the privilege of leading.

My sincere appreciation goes to my late father Prince Oyebamiji Titus Ojo for his interest in education and support for all his children. Though not educated but speaks correct English, known as "Baba Oloyinbo" alias "You see". Also to my late mother Chief (Mrs) Comfort Omobolanle Ojo, a successful fabric Seller (Iya alaso), a very prayerful and strong pillar behind all her children. May the memories of my late parents continue to be blessed, Amen.

To my in-laws, Late Chief Joseph Adegboye Akintayo and Late Mrs. Motunrola Adegboye Akintayo (both of blessed memory), thank you for the prayers, kindness and support in my journey. I appreciate all the Ojo, Adegboye, Aluko-Faari, Asake, and Ogunwusi Families. I thank you all for the love and understanding.

My appreciation extends to my father and mother in the Lord The General Evangelist of Christ Apostolic Church Worldwide Prophet Hezekiah Oluboye Oladeji and Lady Evangelist Esther Omobolanle Oladeji. Your prayers and spiritual covering have brought me to this level of attainment. Also Elder and Prophetess Ezekiel Daodu Atanda,

my Pastors, Evangelists, Elders, Deaconesses and members of my Church, Christ Apostolic Church; Latona English Assembly (Anointing Chapel) Egbatedo, Osogbo; Osun State. Thank you for your prayers and unwavering support at all times.

I'm also grateful to the families of Adekunle, Adewami, Oyediran, Lana, Aina, Prof. J.B Akarakiri, Prof. M.O Ilori and Igbaroola. I appreciate all my friends and well wishers (both home and in diaspora).

Above all, I'm filled with gratitude to my wife, Deaconess Janet Funmilayo Ojo, and children, whose love, endurance, understanding, tolerance, sacrifices, care and quiet strength have sustained me through every season of this journey.

As earlier mentioned, an inaugural lecture is a project. A project has a clear beginning and a defined end.

Thanks for listening.

References

- Abdulla, H., & Al-Hashimi, R. (2019). The impact of project management methodologies on project success: A case study of the oil and gas industry. *Journal of Engineering Project and Production Management*. <https://doi.org/10.2478/jeppm-2019-0013>
- Adeosun, J. O., **Ojo, O. J.**, Lawal, A. F., & Odeyomi, E. S. (2021). Assessment of technical factors influencing buildability of building projects in Osogbo, Osun State, Nigeria. *Premiere Journal of Engineering and Applied Sciences*, 2(4), 9–17.
- Aledare, O., **Ojo, O. J.**, Abayomi, M. A., & Aladejebi, O. A. (2025). Concession practice and the cost of road projects delivery in Southwest Nigeria. *Gas Journal of Engineering and Technology (GASJET)*. <https://doi.org/10.5281/zenodo.16877708>
- Aliyu, A. A., & Tasmin, R. B. H. (2012). The impact of information and communication technology on banks' performance and customer service delivery in the banking industry. *International Journal of Latest Trends in Finance & Economic Sciences*, 2(1). <http://excelingtech.co.uk/>
- Ashaolu, S., **Ojo, O. J.**, Ajayi, M. O., & Sunday, O. G. (2024). Assessment of materials management techniques and inventory control system on public building projects delivery in Southeast, Nigeria. *European Journal of Advances in Engineering and Technology*, 11(3), 71–80.
- Clements, J. P., & Gido, J. (2009). *Effective project management* (4th ed.). Cengage Learning International.
- Crawford, L. H., & Helm, J. (2009). Government and governance: The value of project management in the public sector. *Project Management Journal*, 40(1). <https://doi.org/10.1002/pmj.20107>
- Dvir, D., Lipovetsky, S., Shenhar, A., & Tishler, A. (1998). In search of project classification: A non-universal approach to project success factors. *Research Policy*, 27(9), 915–935.
- Even, A. M. (2024). Project management and education: Improving learning and student success. *International Journal of Curriculum Development and Learning Measurement*, 5(1).
- Fasuyi, O. A., **Ojo, O. J.**, & Ajayi, M. A. (2022). Assessing the effect of community and social development projects on socio-economic development in South West, Nigeria. *International Journal of Advance Research and Innovative Ideas in Education*, 8(5), 1594–1605.
- Harake, M. F. (2023). Project logistics and management: A literature review for project managers. *PM World Journal*, 12(9).

IGI Global. (2018). What is socio-economic development? <http://www.igi-global.com>

Iloyanomon, M. N., Adepoju, A. O., **Ojo, O. J.**, & Aladejebi, O. A. (2023). Factors influencing community participation in State Employment and Expenditure for Result (SEEFOR) projects in Niger Delta, Nigeria. *European Journal of Advances in Engineering and Technology*, 10(5), 27–37.

Kelley, J. E., Jr., & Walker, M. R. (1959). Critical-path planning and scheduling. *Proceedings of the Eastern Joint Computer Conference*, 160–173.

Kerzner, H. (2019). *Project management: A systems approach to planning, scheduling, and controlling* (12th ed.). John Wiley & Sons.

Kloppenborg, T. J., Anantatmula, V., & Wells, K. N. (2019). *Contemporary project management* (4th ed.). Cengage Learning International.

Lawal, A. F., **Ojo, O. J.**, Adeosun, J. O., & Odeyomi, E. S. (2016a). Assessment of project quality management process adopted by building project contractors in Osun State, Nigeria. *International Journal of Environmental Studies and Safety Research*, 1(3), 65–73.

Lawal, A. F., **Ojo, O. J.**, Odeyomi, E. S., & Adeosun, J. O. (2016b). Effect of project success delay factors on real estate development in Osun State, Nigeria. *International Journal of Management Studies, Business and Entrepreneurship Research*, 1(2), 11–24.

Nagarajan, K. (2020). *Project management: Project appraisers, project managers, entrepreneurs, academics, case studies*. New Age International Publishers.

Odeyomi, E. S., Lawal, A. F., **Ojo, O. J.**, & Adeosun, J. O. (2023). Risks associated with real estate projects delivery in Southwest Nigeria. *LAUTECH Journal of Civil and Environmental Studies*, 10(1), 73–81.

Ogunjobi, V. O., **Ojo, O. J.**, Oseni, J. O., & Adebambo, H. O. (2020). Effect of USAID Maximizing Agricultural Revenue and Key Enterprises in Targeted Sites (MARKETS) II project on cocoa production in Ondo State, Nigeria. *American Journal of Research Communication*, 8(12), 1–17.

Ojo, O. J. (2014). Project delivery and human capacity building: Long lasting insecticide treated bed nets delivery in Osun State, Nigeria. *Journal of Sciences and Multidisciplinary Research*, 6(2), 110–117.

Ojo, O. J., & Lawal, A. (2014). Problems affecting public projects execution and control in Southwest Nigeria. *International Journal of Scientific and Engineering Research*, 5(1), 460–463.

Ojo, O. J., & Obembe, J. J. (2014). Evaluation of network analysis application to project management in Southwest Nigeria. *International Journal of Scientific and Engineering Research*, 5(1), 451–454.

Ojo, O. J. (2015a): The Impact of Business Environment on Sawmill Project Investment in Osun State, Nigeria. *Advanced Journal of Business Management and Entrepreneurship*. 3(1), 001-007.

Ojo, O. J. (2015b). Post project review of lumber used for construction of building projects in Osun State, Nigeria. *International Journal of Scientific Research and Innovative Technology*, 2(4), 39–49.

Ojo, O. J., & Kolawole, B. O. (2016). Assessment of information and communication technology management on customer service delivery in Nigeria banking industry. *Journal of Management Studies, Business and Entrepreneurship Research*, 1(1), 66–78.

Ojo, O. J. and Yusuf, B. A. (2016): Assessment of Implementation of Public Procurement Reform in Oyo State, Nigeria. *Journal of Research in National Development*. 14 (2), 124-131.

Ojo, O. J. (2016): Production Practices of Small Scale Sandcrete Block Manufacturer in Osun State, Nigeria. *FUTA Journal of Management Technology*. 1 (2), 62-68.

Ojo, O. J., Iloyanomon, N. M., & Adelusi, K. (2018). Assessment of construction manpower planning in project execution in Akure, Ondo State, Nigeria. *University of Port Harcourt Journal of Management*, 3(1), 160–169.

Ojo, O. J. (2018): Assessment of Environmental Sustainability Considerations for Building Projects Design, Execution and Control in Ibadan, Oyo State, Nigeria. *International Journal of Scientific Research in Science, Engineering and Technology*. 4 (8). Pp.682-689. ISSN: 2395-1990, Print: 2394-4099 (Online).

Ojo, O. J., & Tubie, J. O. (2018). Assessment of application of project management tools and techniques in Niger Delta Development Commission projects in Delta State, Nigeria. *FUTA Journal of Management and Technology*, 1(3), 41–48.

Ojo, O.J., Yusuf, B.A., Adeleye, M. O. (2020). Construction process and Professionals' Perspective in Mitigation of Building Failure in Part of Southwest Nigeria. *Journal of Research in National Development*, 18 (1), 39-43. ISSN: 1596-8308.

Ojo, O. J. (2021). Considerations for building project execution, monitoring and control in parts of Nigeria. *European Journal of Material Sciences*, 8(1), 13–20.

Oyati, E. N., Lawal, A. F., & **Ojo, O. J.** (2021). Assessment of NEWMAP effects on gully erosion control and environmental development over Southeast, Nigeria. *Indian Journal of Environmental Engineering*, 1(2).

Project Management Institute. (2021). *A guide to the project management body of knowledge (PMBOK guide)* (7th ed.).

Rudi, T. De Koker. (2023). The crucial role of project management in advancing healthcare access and universal health coverage. *PM World Library*.

Samuel, S. O. (2015). Community participation in rural development, catalyst for sustainable development efforts. *Proceedings of INTCESS15 – 2nd International Conference on Education and Social Sciences*, Istanbul, Turkey.

Shah, F. H., Bhatti, O. S., & Ahmed, S. (2023). Project management practices in construction projects and their roles in achieving sustainability: A comprehensive review. *Engineering Proceedings*, 44(2). <https://doi.org/10.3390/engproc2023044002>

Taylor, J. C. (2023). *Project scheduling and cost control: Planning, monitoring and controlling the baseline*. J. Ross Publishing.

Tuyisenge, M., & Kabanda, R. (2023). Impact of project planning on performance of agriculture projects at Holland Greentech, Rwanda. *Journal of Entrepreneurship & Project Management*, 3(2), 36–53. <https://doi.org/10.7619/vol3iss2pp36-53>

USAID. (2017). *Maximizing Agricultural Revenue and Key Enterprises in Targeted Sites (MARKETS II): 2017 final update, April 2012–March 2017*. United States Agency for International Development.

Wengrow, D. (2006). *The archaeology of early Egypt: Social transformations in North-East Africa, 10,000 to 2650 BC*. Cambridge University Press.

Youker, R. (1999). The difference between different types of projects. *Proceedings of the 30th Annual Project Management Institute 1999 Seminars & Symposium*, Philadelphia, Pennsylvania.