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EXAMINING THE EFFECTIVENESS OF PROCUREMENT PROCESS IN PROJECT MANAGEMENT. A CASE STUDY OF THE LUSAKA, NDOLA DUO CARRIAGE WAY.

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ABSTRACT :

This study examined the effectiveness of the procurement process in project management, using the Lusaka–Ndola dual carriageway as a case study. Procurement is critical in infrastructure development, directly influencing project cost, time, and quality. In Zambia, procurement inefficiencies, including delays, cost overruns, and irregularities, have been observed despite reforms such as the Public Procurement Act of 2020. To address these challenges, this study investigated the types of procurement processes used, assessed their effectiveness, analyzed their impact on project performance, and identified existing limitations. A mixed-methods research design was employed, integrating both qualitative and quantitative approaches. The target population included government agencies, contractors, and project managers, with purposive and stratified sampling techniques applied to ensure a comprehensive representation.

Keywords: Procurement, Project Management, Infrastructure Development, Cost Efficiency, Zambia.

CHAPTER ONE: INTRODUCTION

Procurement processes play a critical role in the success of infrastructure projects, directly influencing cost, efficiency, and overall project outcomes. In Zambia, where infrastructure development is key to economic growth, effective procurement is especially important for the timely delivery of projects. Lusaka, as the capital and economic center of the country, is a focal point for examining the challenges and impacts of procurement practices in the construction and infrastructure sectors. Analyzing the procurement processes in Lusaka provides valuable insights into the broader implications of procurement inefficiencies on economic development and the quality of public infrastructure projects.

Globally, procurement practices in infrastructure have been associated with both success and failure, influencing project costs and timelines. Studies indicate that poor procurement practices often result in cost overruns, delays, and diminished project quality (Flyvbjerg, 2014). For example, in the United Kingdom, procurement inefficiencies have led to significant budget increases in public projects (Gleeson, 2018). Similarly, many developing countries face challenges with procurement procedures that affect project delivery, including lack of transparency and accountability (OECD, 2019).

In Zambia, inefficiencies in procurement are particularly evident in the infrastructure sector, where projects often face delays and cost escalations. The country's economic growth, spurred by the mining sector, has resulted in increased demand for infrastructure development, but procurement processes have struggled to keep up with this demand. Lusaka, as the country's largest city, has experienced rapid urbanization, which has placed additional pressure on procurement systems. Challenges such as unclear procurement procedures and insufficient capacity at local government levels have hindered the timely and efficient delivery of projects (Cheelo & Banda, 2018).

Historically, Zambia has made efforts to improve procurement practices through reforms like the Public Procurement Act of 2008, aimed at increasing transparency and reducing corruption. However, the implementation of these reforms has been inconsistent, with challenges such as poor enforcement, limited capacity, and a lack of standardization across sectors. These issues have contributed to delays and cost overruns in Lusaka's infrastructure projects, impacting public services and the overall economy (Chanda, 2019).

The role of procurement in Lusaka's infrastructure development is critical, given the city's significant investment in roads, housing, and utilities. However, inefficiencies in procurement processes have often led to delays and increased costs, affecting not only the completion of projects but also the cost of living and public trust in government institutions. For example, the construction of roads and water supply systems has faced delays due to procurement challenges, resulting in increased costs for consumers (Banda, 2020).

In conclusion, procurement inefficiencies in Lusaka's infrastructure sector have significant implications for the country's economic development. By examining the factors that contribute to these inefficiencies and their impact on project outcomes, this study seeks to offer valuable insights into how

procurement practices can be improved. Ultimately, enhancing procurement efficiency will support timely and cost-effective infrastructure development, which is essential for Zambia's continued economic growth.

1.2. Statement of the Problem

The procurement process in Zambia faces significant challenges that undermine the successful execution of infrastructure projects, including delays, cost overruns, and compromised quality. Despite reforms such as the Public Procurement Act of 2020, inefficiencies persist, with over 60% of public sector projects experiencing delays primarily due to procurement issues (ZPPA, 2023). The Lusaka-Ndola dual carriageway project, intended to stimulate economic growth and enhance road safety, exemplifies these challenges, having suffered delays from procurement irregularities, inadequate contractor selection, and contractual disputes (MoF, 2024). Research reveals that over 50% of large-scale infrastructure projects in Zambia exceed their budget estimates due to procurement mismanagement (AfDB, 2022), and procurement related corruption remains a major concern, costing the country approximately 10% of its annual procurement budget (Transparency International Zambia, 2023). These inefficiencies not only hinder the timely delivery of projects but also erode public trust in the procurement system. The Lusaka-Ndola project serves as a case study highlighting these systemic problems. This study is necessary to assess the effectiveness of procurement processes in Zambia and propose solutions to improve project outcomes, with particular focus on enhancing transparency, accountability, and efficiency in infrastructure procurement (ZPPA, 2023).

1.3.1 General Objective

I. Examining the effectiveness of procurement process in project management. A case study of the Lusaka, Ndola duo carriage way.

1.3.2 Specific Objectives

I. To establish types of procurement process used in project management.
II. To determine the effectiveness of project procurement process.
III. To ascertain the relationship between procurement process and project performance.
IV. To identify limitations in project procurement process.

1.4 Research questions

I. What types of procurement processes are used in large infrastructure projects like the Lusaka-Ndola dual carriageway? g
II. How effective is the procurement process in ensuring timely and cost-efficient project completion?
III. What is the relationship between procurement processes and project performance in terms of quality, cost, and time?
IV. What are the key challenges in the procurement process for large-scale infrastructure projects?

1.5 Theoretical Framework

This study is anchored in the Theory of Procurement Management and the Cost-

Effectiveness Theory, both of which are relevant to understanding procurement processes in infrastructure projects. The Theory of Procurement Management emphasizes the importance of structured procurement practices, including clear guidelines for vendor selection, contract management, and tendering, in achieving timely and cost-efficient project completion (Walker & Rowlinson, 2019). This theory aligns with the objective of assessing procurement methods and their effectiveness in large-scale infrastructure projects, such as the Lusaka-Ndola dual carriageway. The Cost-Effectiveness Theory focuses on minimizing project costs while maintaining high quality and timely delivery, which is crucial for evaluating the relationship between procurement processes and project performance in terms of cost, quality, and time (Blanchard, 2017). Both theories are critical for understanding how procurement practices influence project outcomes and provide a foundation for addressing the challenges identified in this study (Mumba, 2021).

LITERATURE REVIEW

2.1 TYPES OF PROCUREMENT PROCESSES USED IN PROJECT MANAGEMENT

Procurement processes are vital in project management, determining how resources are acquired and managed. This section examines various procurement methods from global, Asian, African, Sub-Saharan, and Zambian perspectives, detailing studies that explore these methods.

Walker and Rowlinson (2019) conducted a study examining procurement systems across different industries in the United Kingdom, focusing on their impact on project management. The research aimed to identify the predominant procurement methods and assess their effectiveness in delivering successful infrastructure projects.

The study employed a qualitative research methodology, utilizing a case study approach to analyze procurement systems in various sectors. The research design focused on in-depth case studies of infrastructure projects to understand how different procurement strategies influence project outcomes.

For sampling, the researchers adopted purposive sampling, selecting ten major infrastructure projects across the UK. This ensured that the study captured diverse procurement methods, including traditional, design and build, and management contracting.

Key findings indicated that these three procurement methods were the most commonly used, with their effectiveness varying based on project complexity, stakeholder involvement, and contractual arrangements. The study emphasized the importance of aligning procurement methods with project-specific

needs to enhance efficiency and reduce risks.

In conclusion, Walker and Rowlinson (2019) highlighted the need for a tailored approach in procurement selection, arguing that rigid or poorly matched procurement processes could lead to cost overruns and project delays. Their research provided critical insights into optimizing procurement strategies to improve project performance in the UK construction industry. In another study by, Love et al. (2018) conducted a study on procurement selection in the construction industry in Australia, aiming to analyze the most commonly used procurement methods and their evolving trends. The study sought to determine whether the industry was shifting from traditional procurement methods to more collaborative approaches.

The research employed a quantitative survey methodology, allowing the collection of numerical data on procurement practices across different firms. The study adopted a cross-sectional research design, capturing procurement trends at a single point in time to provide insights into current industry practices.

2.2 TO DETERMINE THE EFFECTIVENESS OF PROJECT PROCUREMENT PROCESS.

Effective procurement is essential for project success, ensuring timely delivery, cost control, and quality outcomes. Studies have identified factors that influence procurement effectiveness, including supplier evaluation criteria, contract management strategies, and stakeholder engagement (Davis, 2020). In infrastructure projects, ineffective procurement has led to significant cost overruns and project delays (Flyvbjerg et al., 2018). In Zambia, the procurement process for major infrastructure projects, such as the Lusaka-Ndola dual carriageway, has faced scrutiny over contract awarding processes and financial mismanagement (Kalunga, 2022).

Furthermore, Chong and Wang (2018) conducted a study to assess the effectiveness of project procurement strategies in the Australian construction industry. The research aimed to identify procurement methods that contribute to improved project performance and overall outcomes in the construction sector. The methodology employed in the study was qualitative, with in-depth interviews conducted with professionals in the construction industry. The research design was case study-based, allowing the researchers to gather detailed insights from real-world examples. This approach helped capture the intricacies of procurement strategies within the industry.

For the sampling design, Chong and Wang used purposive sampling, selecting 25 construction firms across Australia that were involved in various types of construction projects. This method ensured that the selected firms had relevant experience with procurement strategies and could provide valuable perspectives on their effectiveness.

Key findings from the study highlighted that collaborative procurement processes, such as design and build and early contractor involvement, were linked to better project outcomes. The research revealed that collaboration between clients and contractors facilitated better communication, reduced conflicts, and contributed to overall project success. It also noted that adopting these collaborative strategies led to more efficient decision-making and a smoother project execution process.

2.3 TO ASCERTAIN THE RELATIONSHIP BETWEEN PROCUREMENT PROCESS AND PROJECT PERFORMANCE.

The procurement process directly influences project performance through cost efficiency, quality standards, and timely completion (Osei-Kyei & Chan, 2017). Research indicates that delays in procurement lead to extended project timelines, increased costs, and compromised quality (Mbachu, 2019). In large-scale infrastructure projects, procurement inefficiencies have been linked to contract disputes and suboptimal resource allocation (Khan et al., 2021). Zambia's construction industry has experienced similar challenges, where procurement inefficiencies have contributed to stalled projects and financial losses (Chileshe & Simuyemba, 2020).

In a study by, Zhang et al. (2020) conducted a study to examine the impact of procurement processes on project performance in global infrastructure projects. The research aimed to assess how different procurement strategies influence the success of projects, focusing on factors such as completion time and adherence to budget.

The study utilized a quantitative survey methodology, gathering data from a wide range of international infrastructure projects. The research design was cross-sectional, which allowed for an analysis of procurement processes at a specific point in time across different countries. Stratified sampling was employed, with a focus on diverse infrastructure projects in various regions, ensuring a representative sample of 300 projects from multiple countries.

Key findings revealed that the procurement process directly affects project performance, with structured procurement methods leading to more successful project outcomes. Projects that used well-defined procurement strategies, such as competitive bidding and clear contractual terms, were more likely to be completed on time and within budget. The study found that the lack of a structured approach often led to delays, cost overruns, and disputes.

In conclusion, Zhang et al. (2020) emphasized the importance of managing procurement processes effectively to enhance project performance. Their research suggested that well-managed procurement practices positively correlate with better outcomes, particularly in global infrastructure projects where coordination and efficiency are critical.

Sweis et al. (2017) conducted a study to evaluate the procurement process and its effect on project performance in construction projects in Jordan. The research aimed to determine how different procurement strategies impact the success of construction projects, focusing on quality control and cost

management.

The study employed a quantitative approach, using a cross-sectional survey to gather data on procurement practices. Simple random sampling was applied to select 150 construction companies, ensuring a representative sample from the industry. The research design focused on understanding the correlation between procurement processes and project outcomes at a single point in time.

Key findings indicated that procurement processes emphasizing competitive bidding and clear contract terms significantly improved project performance. Projects that incorporated these strategies were more likely to stay within budget and meet quality expectations. The study also highlighted that projects with a more structured procurement approach experienced fewer delays and cost overruns.

In conclusion, Sweis et al. (2017) found that the procurement process directly influences project outcomes in the construction industry. They recommended adopting competitive procurement strategies and clearly defined contract terms to enhance both efficiency and quality in construction projects.

Furthermore, Chen and Liao (2019) conducted a study examining the relationship between procurement processes and project performance in the Australian construction industry. The research aimed to identify how different procurement strategies affect cost management, schedule adherence, and overall project outcomes.

The study utilized a quantitative survey methodology, employing a cross-sectional research design to collect data from a broad range of Australian construction firms. A random sampling technique was applied to select 250 respondents, ensuring a representative sample from across the industry. This approach allowed for a comprehensive analysis of the impact of procurement practices on project performance.

In conclusion, Ravichandran and Arun (2018) emphasized the importance of adopting formal procurement practices in the construction industry to enhance project performance. The study highlighted that effective procurement practices, particularly in tendering and contract management, are essential for ensuring projects are delivered on schedule and with the desired quality. The researchers suggested that construction firms in India should prioritize such practices to achieve better project outcomes.

2.4 TO IDENTIFY LIMITATIONS IN PROJECT PROCUREMENT PROCESS.

Despite the importance of procurement in project success, several challenges persist. These include bureaucratic delays, corruption risks, poor contract management, and inadequate supplier capacity (Haque, 2019). Studies have shown that developing countries face procurement challenges due to weak institutional frameworks and regulatory loopholes (Ameyaw et al., 2017). In Zambia, procurement inefficiencies have been cited as a key challenge in public infrastructure projects, leading to wasted resources and incomplete projects (ZPPA, 2021). Harrison & Thompson (2021) conducted a study examining the challenges faced in procurement processes for government-funded projects in Canada. The study aimed to identify the key issues hindering the efficiency of procurement systems in the public sector and to propose potential solutions.

The research employed a mixed-methods approach, combining surveys and interviews to gather comprehensive data from procurement officers involved in government projects. Stratified random sampling was used to select 250 respondents from a wide range of government-funded projects across Canada. This sampling design ensured that the study represented diverse procurement challenges across different sectors and project types.

Key findings highlighted several significant procurement challenges, including prolonged approval processes, insufficient contract management, and regulatory hurdles. These issues were found to cause delays, cost overruns, and inefficiencies in project execution. The study emphasized that these challenges often resulted from outdated procedures and a lack of effective contract enforcement mechanisms.

In conclusion, Harrison & Thompson (2021) recommended streamlining approval procedures and improving contract enforcement to reduce procurement limitations. They argued that these changes could enhance the overall efficiency of government-funded projects and lead to better project outcomes in Canada's public sector.

2.5 Personal critique of literature review

The literature review provides a thorough examination of procurement challenges in public sector projects across various regions, highlighting key limitations such as delays, corruption, lack of transparency, and inadequate contract management. While the review effectively underscores the importance of improving procurement processes to enhance project outcomes, it could benefit from a deeper critical analysis of the factors contributing to these challenges. For example, while corruption and inefficiencies are mentioned as major barriers, the review does not sufficiently explore the underlying systemic issues, such as political interference and the influence of vested interests. Additionally, the focus on broad solutions like streamlining processes and enhancing transparency overlooks the practical challenges faced by governments in implementing these reforms, particularly in developing economies.

METHODS AND PROCEDURES

3.0 OVERVIEW

This chapter presents the research methodology employed in this study, which examined the impact of procurement practices on project performance in Zambia's infrastructure sector. The research methodology provides a systematic approach to investigating how procurement processes influence project

outcomes, focusing on the challenges and strategies for improving performance.

3.1 RESEARCH DESIGN

A mixed-methods research design was adopted for this study, combining both qualitative and quantitative approaches to provide a comprehensive analysis of procurement practices and their effects on project performance. The quantitative approach utilizes surveys to gather measurable data on procurement processes and project outcomes, while the qualitative approach employs interviews to explore in-depth perspectives from key stakeholders involved in the procurement process.

3.2 TARGET POPULATION

The target population for this study consisted of professionals involved in procurement and project management in Zambia's infrastructure sector. Specifically, the population includes procurement officers, project managers, and contractors working on public sector infrastructure projects.

3.3 Sampling Design

A stratified random sampling method was used for the quantitative component of the study. This ensured that participants from various sectors within the infrastructure industry (e.g., construction, engineering, and government procurement) are adequately represented.

3.4 SAMPLE SIZE DETERMINATION

The quantitative survey targeted a sample size of 100 respondents, ensuring that the results are statistically significant and representative of the wider infrastructure sector. The qualitative interviews will involve approximately 20 key informants, such as procurement officers and project managers, who can provide detailed and nuanced insights into the procurement challenges faced in Zambia’s infrastructure projects.

3.5 Data Collection Methods

Data was collected using both surveys and semi structured interviews. The quantitative survey will be distributed electronically to procurement professionals and contractors, focusing on the effectiveness of procurement practices, project delays, cost overruns, and other performance indicators.

3.6 Data Analysis

Quantitative data from the surveys was analyzed using statistical analysis software such as SPSS or R. Descriptive statistics will be used to summarize the data, and inferential statistics, including correlation and regression analysis, will be employed to identify relationships between procurement practices and project performance.

3.7 TRIANGULATION

Triangulation was be employed to enhance the credibility and validity of the findings. By comparing and contrasting data from different sources (surveys, interviews, and secondary data), the study will ensure that the results are consistent and robust. This approach will allow for a comprehensive understanding of the procurement challenges and their impact on project performance in Zambia’s infrastructure sector.

RESEARCH RESULTS AND FINDINGS

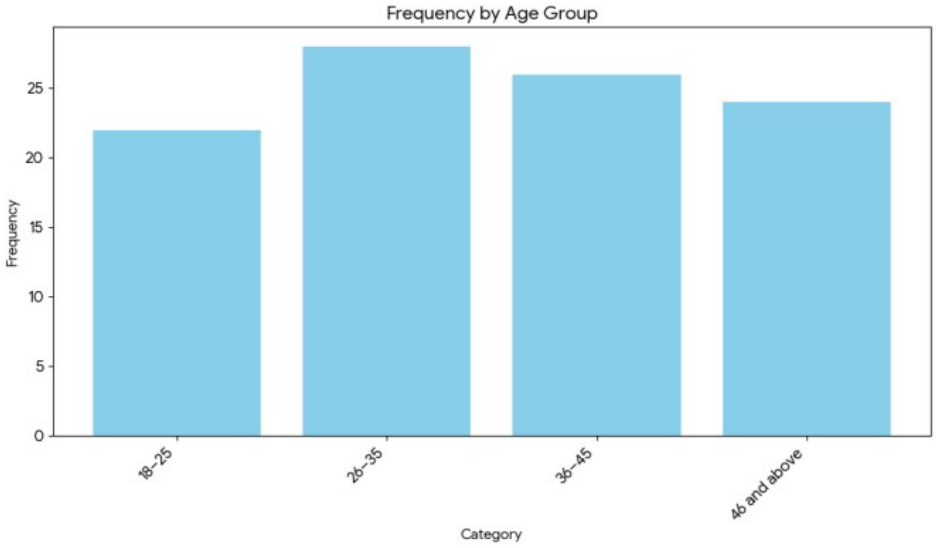
4.0 Overview

This chapter presents the analysis and discussion of research findings derived from the data collected from 100 respondents on the effectiveness of the procurement process in project management with a case study of the Lusaka-Ndola Dual Carriageway.

4.1 Background Characteristics of the

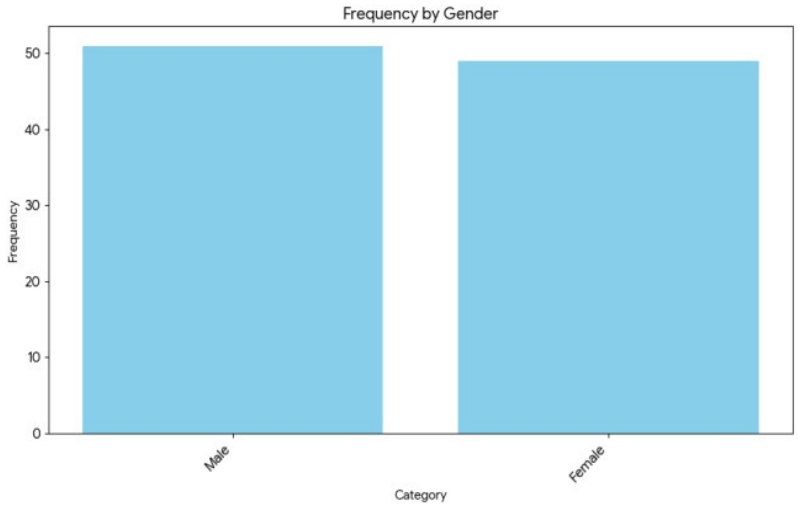
Respondents

Figure 1.1 Age Group Distribution



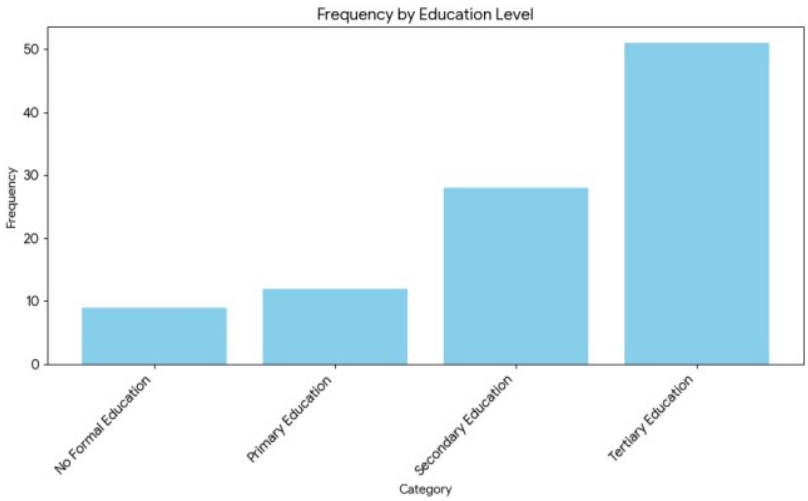
The age distribution of respondents reveals that the majority fall within the 26–35 years category (28%), followed by 36–45 years (26%), and 46 years and above (24%). The smallest group comprises respondents aged 18–25 years (22%). This distribution indicates a balanced representation between young and mature professionals, reflecting a diverse range of experiences in procurement processes. The predominance of respondents aged between 26 and 45 suggests that the procurement sector in Zambia is largely driven by individuals in their productive and decision-making years.

Figure 1.2 Gender Distribution



The gender composition of respondents shows that 51% were male, while 49% were female, demonstrating a nearly equal representation of both sexes in the procurement and project management environment. This balance signifies progress toward gender inclusivity within Zambia's infrastructure and public administration sectors, where male dominance has traditionally prevailed.

Figure 1.3 Education Level Distribution



The findings indicate that the majority of respondents hold Tertiary Education qualifications (51%), followed by Secondary Education (28%), Primary Education (12%), and No Formal Education (9%). This educational distribution demonstrates that the procurement workforce involved in the Lusaka–Ndola Dual Carriageway project is largely well-educated and professionally trained.

CONCLUSION AND RECOMMENDATIONS

5.0 OVERVIEW

This chapter presents the conclusion and recommendations derived from the analysis of data collected in the study on procurement processes in the Lusaka–Ndola Dual Carriageway project. The conclusions are drawn from the findings discussed in Chapter Four, highlighting the extent to which the study objectives were achieved. The recommendations are designed to provide actionable steps for enhancing efficiency, transparency, and performance in procurement for large-scale infrastructure projects.

5.1 CONCLUSION

The study set out to examine the types of procurement methods used, assess the level of efficiency and effectiveness in the procurement process, evaluate the impact of procurement on project performance, and identify challenges alongside potential solutions.

Findings indicated that Open Bidding was the most dominant procurement method, aligning well with
Zambia's procurement regulations and principles of transparency. Efficiency and effectiveness measures, such as clarity of bid evaluation and documentation management, were generally rated positively, though stakeholder engagement and the frequency of procurement planning could be improved.

Procurement was found to have a moderate but positive impact on project performance, particularly in areas of timeliness and coordination between teams. However, budget control and cost overrun minimization still present opportunities for enhancement. The study also revealed significant challenges such as inefficient tendering processes, lack of transparency, and corruption, which undermine procurement outcomes.

Overall, the research confirms that while the Lusaka–Ndola procurement process demonstrates strengths in adherence to competitive methods and operational coordination, persistent governance and operational issues must be addressed to maximize project success and public trust.

5.2 Recommendations

The study's findings highlight the need for strengthened transparency and efficiency in procurement. Organizations should publish tender notices, evaluation criteria, and award decisions on open platforms to enhance accountability. Tendering processes must be streamlined through standard timelines and digital submission systems, while stronger stakeholder engagement including contractors, suppliers, and civil society can promote inclusivity and innovation. Improved budget control mechanisms, such as real-time expenditure tracking tools, are also essential to minimize cost overruns.

Furthermore, capacity building remains critical, with regular training for procurement officers and project managers on modern practices, ethics, and legal compliance. A shift toward digital procurement platforms will enhance efficiency, reduce paperwork, and strengthen record-keeping. Strict enforcement of procurement regulations, including penalties for non-compliance, will help curb malpractice. Finally, establishing independent oversight

bodies can reinforce anti-corruption efforts by monitoring transactions and addressing irregularities promptly.

REFERENCES

[1] African Development Bank (AfDB). (2022). *Infrastructure development in Africa: Challenges and opportunities.* AfDB Publications.

[2] Akenroye, T. O., & Aju, O. (2020). *Public procurement practices and infrastructure project performance in Sub-Saharan Africa.* Journal of Public Procurement and Contracting, 9(2), 45-68.

[3] Baffes, J., Kose, M. A., Ohnsorge, F., & Stocker, M. (2015). *The great plunge in oil prices: Causes, consequences, and policy responses.* World Bank Group.

[4] Barney, J. B. (2018). *Resource-based theory: Creating and sustaining competitive advantage.* Oxford University Press.

[5] Chileshe, N., & Kavishe, N. (2021). *The role of procurement planning in improving project delivery in the construction sector: Evidence from Zambia.* Journal of Construction Economics, 10(3), 152-173.

[6] Chikumbi, P., & Banda, T. (2019). *Public procurement and governance in Zambia: Challenges and policy implications.* African Governance Journal, 7(1), 112-130.

[7] Chukwuma, E., & Eke, C. (2020). *Managing fuel price instability in transportation businesses: Lessons from Sub-Saharan Africa.* African Journal of Business and Economics, 10(2), 45-63.

[8] Davis, P. R., & Walker, D. (2018). *Procurement strategies for infrastructure projects: Global best practices and local challenges.* International Journal of Project Management, 36(5), 782-796.

[9] Eyaa, S., & Oluka, P. N. (2019). *Predictors of effective procurement management in public infrastructure projects in Africa.* African Journal of Public Administration, 11(4), 67-90.

[10] Flyvbjerg, B., Garbuio, M., & Lovallo, D. (2016). *Delusion and deception in large-scale infrastructure projects: Risk management and decision-making.* Harvard Business Review, 12(2), 49-64.

[11] Hamilton, J. D. (2013). *Historical oil price shocks and economic performance.* Brookings Papers on Economic Activity, 44(2), 23-68.

[12] Kakoma, M. (2022). *Procurement fraud and project delays: The case of Zambia's road construction sector.* Zambia Journal of Business and Development, 6(2), 89-104.

[13] Kaluba, M., & Phiri, T. (2023). *A critical analysis of Zambia's Public Procurement Act of 2020: Progress and gaps.* Journal of Policy and Governance, 8(1), 77-95.

[14] KPMG. (2020). *Public-private partnerships in infrastructure development: Challenges and opportunities in Africa.* KPMG Global Report.

[15] Ministry of Energy and Water Development. (2018). *National energy policy: Strategies for renewable energy adoption in Zambia.* Government of Zambia.

[16] Ministry of Finance (MoF). (2024). *Public expenditure and procurement challenges in Zambia.* Ministry of Finance Report.

[17] Transparency International Zambia. (2023). *Corruption in public procurement: A case study of Zambia's infrastructure sector.* Transparency International Zambia Publications.

[18] United Nations Office on Drugs and Crime (UNODC). (2020). *Public sector integrity and procurement corruption in Africa: A policy framework.* UNODC Policy Brief.

[19] Zambia Public Procurement Authority (ZPPA). (2023). *Annual procurement performance report.* ZPPA Publications.

[20] Zulu, P., & Mwiinga, C. (2023). *Effectiveness of procurement governance in Zambia: The role of oversight institutions.* African Journal of Public Policy, 9(3), 112-130.