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Evaluating Effectiveness of Material Management Strategies in Project Management: A Case Study of the Chinsali-Nakonde Road

[1] Alice Kasempa, [2] Dr. Kelvin Chibomba

[1, 2] Department of Research and Social Sciences, Information and Communications University, Lusaka, Zambia

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Corresponding Author: **Alice Kasempa**

Abstract

Construction material is a critical element in the construction project as it contributes a major portion to the cost of projects. The contribution of construction materials may account 50-60 % of the project cost. Due to its role as the major contributor to project cost, managing construction material becomes essential function in the construction project. Therefore, material management is an important element in project management. Construction materials contribute significantly to project performance. Several authors claim that this contribution may be up to 70% (Zairra Mat Jusoh, 2018) of the project cost. This contribution varies according to the type of contract that is agreed upon in every construction project. Even though materials management is important, this area has received less attention from academician and researchers, as stressed by previous authors**.** The results of this study provide significant insights into the effectiveness of material management strategies in project management, using the Chinsali-Nakonde road project as a case study. Each aspect of material management planning, transportation, storage, and purchasing was found to play a crucial role in determining the overall performance of the project. This section critically examines these findings in the context of existing literature and theoretical frameworks.

The findings underscore the pivotal role of planning in material management, with 85% of respondents acknowledging its direct impact on project timelines and cost efficiency. This aligns with the principles outlined in the Project Management Body of Knowledge, which highlights planning as a cornerstone of effective project management. Detailed planning allowed the project team to anticipate material needs, reduce downtime, and avoid emergency procurements. These results are consistent with studies by Paez (2005), which found that inadequate planning often leads to cost overruns and project delays. By contrast, the structured approach observed in this case study demonstrates the value of robust planning practices in optimizing resource allocation and mitigating risks. However, the study also highlighted gaps in contingency planning, particularly for unforeseen disruptions, suggesting the need for more comprehensive risk assessments. Transportation emerged as a critical factor, with 92% of respondents reporting that efficient logistical systems improved material availability and reduced costs.

Keywords: Material Management, Strategies, Project, Management, Road

1. Introduction

1.1 Background of the study

Construction material is a critical element in the construction project as it contributes a major portion to the cost of projects. The contribution of construction materials may account 50-60 % of the project cost. Due to its role as the major contributor to project cost, managing construction material becomes essential function in the construction project. Therefore, material management is an important element in project management.

Despite the major productivity revolution in the manufacturing sector over the past five decades, the construction industry still faces challenges in improving its productivity levels. Construction projects of significant scale and cost often surpass the estimated initial timeframes, leading to various challenges and complications as the complexity of these projects increases. (McKinsey & Company 2017). The obstacle to increased productivity has been the fact that many parties, such as designers, contractors, customers, subcontractors, and consultants, are usually involved in construction contracts, which increases potential conflicts between the parties involved.

The industry is used to traditional project models where the parties make two-way agreements, therefore, goals and plans are not made collectively. Also, as the number of individuals involved in the project increases, the project manager should possess exceptional communication skills and a systematic leadership approach. (Rakennuslehti 2017) Waste and productivity go hand in hand in production. According to En-Nadi *et al*. (2017) [18] Waste reduction plays a crucial role in the foundation of lean construction. Lean is the westernization of the Japanese concept, which bears many names, such as JIT (Just-in Time) or pull manufacturing. Lean construction and these Japanese concepts share same core principles aimed at minimizing waste and improving efficiency (Dubey & Singh 2015). The JIT system was originally invented in the 1950s by Mr. Taiichi Ohno at Toyota Motor Corporation. The system managed to improve the quality and reliability of Toyota cars, but also productivity was increased while the inventory levels were controlled, costs were reduced, and the amount of waste was decreased. (Pheng & Hui 2019) The Finnish construction industry's awareness of lean thinking has increased in the past few years. Lean has inspired the construction industry toward more predictable and efficient project production, focusing on minimizing waiting times between work phases and eliminating waste.

The active involvement of various stakeholders in production planning fosters enhanced customer satisfaction and the delivery of greater value to customers. (Rakennuslehti 2020) Traditionally, the construction industry in Finland has adhered to a week-level precision approach, leading to delays and inaccuracies in material deliveries. Consequently, materials are often ordered well in advance, so buffering is relatively standard. These practices contribute to excessive inventories and an increased risk of material damage.

1.2 Problem Statement

Construction materials contribute significantly to project performance. Several authors claim that this contribution may be up to 70% (Zairra Mat Jusoh, 2018) of the project cost. This contribution varies according to the type of contract that is agreed upon in every construction project. Even though materials management is important, this area has received less attention from academician and researchers, as stressed by previous authors. Prominently, past studies do not sufficiently address the influential factors that contribute to effective materials management. (Zairra Mat Jusoh, 2018) Construction companies suffer from several instances of project failure attributed to poor material management. Project delays occur due to transport delays, material damage due to poor storage facilities, poor initial planning and also inadequate purchasing procedures.

These challenges are manifested in projects in form of stoppage of work due to material shortages, surplus materials on site, inadequate storage space for materials, uncontrolled wastage of materials, damaged materials on site and wrongful purchase of materials. The ultimate impact is project failure. Poor material management techniques adopted in project implementation have contributed to the increased number of abandoned projects due to increased project costs and timelines which are unviable in the long run. Most of these incomplete projects in the construction sector pose a great risk to the livelihoods of the society considering some have collapsed resulting into the loss of lives and property.

It is also a major financial risk given the investments put into the construction works. The study by Mac-Barango (2017) revealed that poor material handling and mismanagement was part of the reasons for incomplete projects. He delved into store management but he did not focus on the transport management problems which adversely affect the management of materials. It is also important to establish the relationship between storage and transport processes. Kioko (2014) on the other hand reported that material mismanagement had impacted negatively on project completion.

1.3 Objective of the Study

1.3.1 General Objective

The main aim of this research was to evaluate effectiveness of material management strategies in project management: a case study of the Chinsali -Nakonde road

1.3.2 Specific Objectives

1. To determine the effects of planning in material management on project performance.
2. To establish how transportation of material management enhances project performance.
3. To determine the effects of material storage in material management on project performance.

1.4 Theoretical framework

Resource Dependency Theory was created by Jeffrey Pfiffer and Gerald Salancik in 1987. The theory focusses on a set of power relationships based on exchange of resources (Pfeffer & Alison, 1987). It recognizes that companies do not possess all the resources they might require in the process of value creation, hence will often become dependent on each other (Hunt & Morgan, 1996). This theory is particularly effective in transport and storage of materials. Transportation and storage must be done effectively since the material used in the process is very scarce. The main issue is how organizations manage their power dependence relationships to maintain their functional and operational requirements (Pfeffer & Salancik, 1978). In this regard, RDT assumes that organizations often form coalitions to increase their power and make other organizations dependent on themselves (Heide, 1994).

Resource manipulation and control exertion are the strategies offered by RDT to manage uncertainty and dependence in business transactions. The resource dependency theory is relevant to this study as it highlights the key project aspects such as sourcing materials and transport of the materials from the supplier that directly influence project performance. Therefore, every project is dependent on a good material management to yield the required results. He year 2008 marked the 30th anniversary of the publication of Pfeffer and Salancik's (1978) The External Control of Organizations: A Resource Dependence Perspective. Since its publication, resource dependence theory (RDT) has become one of the most influential theories in organizational theory and strategic management. RDT characterizes the corporation as an open system, dependent on contingencies in the external environment (Pfeffer & Salancik, 1978).

2. Literature Review

2.0 Overview

2.1 The Effects of Planning in Material Management on Project Performance

Projects are important drivers to socio-economic development. According to Hapompwe *et al*. (2020), socio economic development is the primary pre-occupation of any nation globally in trying to enhance human welfare through various econometric strategies, techniques, and measures in order to guarantee the provision and accessibility to basic needs.... It should, however, be stressed that development projects as being among many other strategies for attaining meaningful livelihoods for the citizens of nations through job creation, poverty reduction and inequality minimization come with inherent challenges which in some cases have ended up worsening socio-economic situations of intended beneficiaries. Besides, infrastructure development is critical for any sound and meaningful development to take place (Hapompwe, Banda, & Chalwe (2024) which is achieved through strategic project investments anchored on sound project management practices and strategies for effective implementation and value realization.

Effective project management is essential for the success and efficiency of construction projects. Mir and Pinnington (2022) highlight the importance of meticulous project planning, which optimizes resource allocation and improves project outcomes. Aminbakhsh *et al*. (2021), further corroborate this by identifying resource allocation issues as significant contributors to project delays and cost overruns.

Further, Belout (2023) identified effective communication as another critical aspect of project management. Belout and Gauvreau (2023) emphasized that clear and timely communication among stakeholders' fosters collaboration, reduces misunderstandings and enhances decision-making processes. Conversely, inadequate communication can lead to delays, rework, discord, and jeopardize project success.

2.2 How Transportation of Material Management Enhances Project Performance.

Modelling of inventory management in construction operations which involves on-site fabrication of raw materials was made by Young (2015). The research was done to decide an optimal level of material inventories on considering vibrant variations of resources under uncertainty is very critical for the economic efficiency of construction projects. This paper developed a probabilistic optimal inventory management model on the process of on –site fabrication of raw materials such as iron –rebar process. From the research it was concluded that, the amount of inflow and outflow iron-bars at the temporary shop attained a stability by applying the pull system to the phase of raw material inventory management, moreover average inventory quantity were reducing and by eliciting optimal time lags linking to the start of fabrication/assembly works. It was likely to reduce the holding time of assembled products and inventory management costs could be reduced around a total of 25%. S curve analysis was done to check the deviations in the progress of the scheduled project. The tracking should be done then and there to find the fault in earlier stage itself. Pande (2015) carried out S curve analysis using MSP software's curve analysis was done to compare the planned and actual material consumption. The deviations curve in the S shade graph produces by the increasing expenditure of certain parameters against time was the representation of the project path. This analysis was carried for comparison of planned and actual cost for material.

The author concluded that due to deviation in items the consequences would be on material procurement which affects the project budget. Many buildings and projects are springing up in various parts of this country. Every contractor is very keen on completing their projects on time as they seek to make more money. While time is a core aspect of project management, most of the contractors lack proper quality inspection procedures to ensure the quality of the material used. Sometimes the material used is weak ending up causing further damage to the projects. These are process that should be undertaken in the sourcing stages to avoid the issues that arise later in project as it progresses. According to Pancharathi (2013), most of the standards and codes used for construction projects are foreign, mainly obtained from Britain, India and China. Unfortunately, the material used in Kenya and in those countries is not the same. This is an indication that the Kenyan authorities have not invested on studying the codes and giving suitable recommendations on suitable ratios to be used in the construction. This results in substandard structures that end up collapsing.

2.3 The effects of material storage in material management on project performance

Aini (2019) during the past years, various academics researchers have conducted studies investigating to find out the issues causing ineffective materials management in construction projects. A research 20 done by Gulghane & Khandve (2015) state that the problematic management of material are due to overstock materials because of improper planning, damaged materials due to logistics, handling or in application, loss of materials because of improper supervision, waiting of the materials to arrive in location due to improper tracking system, frequent movement of materials due to improper site layout, inflation, material changes in buying or purchasing situation starting from the prepared cost estimation, bulk construction material, the shortage and changes of construction materials quantity required, material inefficient on site, stealing and loss of construction material, material shipment, work repairing delay in updating or posting, storage system on site, inaccurate estimation of shipment quantity of materials, uneconomical order quantity of materials, poor shipping times, increasing transport cost of materials, material over usage in location of project, choosing the wrong materials for construction, increasing storage cost of materials, the poor buying ability of managers and delay of payment for materials. In a study conducted by Wanjari & Dobariya (2016), the highest causing cost overrun in Indian construction industry was identified as price escalation of raw materials. In another study done by Cheng (2014) about an exploration into cost influencing factors on construction projects revealed that material shortage or supply delay is prominent project risk that will influence the project cost. Similarly, a study conducted to identify the delay factors in construction projects of Turkey found out that material is significant factor causing delay (Gunduz, 2013). Furthermore, it was explained that problems such as late delivery of materials, poor procurement of construction material and shortage of construction materials are prime factors causing project delay. Unlike storage and transport costs, time delays and quality which are is more subjective,

the factors affecting the quality of a project are perceived differently by the contractor, consultant and client. This is because due to individual interest, knowledge and their judgment. Therefore, the study helped justify the significance of improving material management process in construction industry in Kenya to implement more successful project. From the literature review it is very clear that material management plays a vital role in the construction field. Whether it is a small firm or large firm the material management should be done. Material management holds a part right from purchasing of materials till its utilization.

3. Methods and Procedures

3.0 Overview

This chapter outlines the research methodology employed in evaluating the effectiveness of material management strategies in project management, with a focus on the Chinsali-Nakonde road project. The methodology includes the research design, target population, sampling design, data collection methods, data analysis techniques, and the use of triangulation to ensure validity. Limitations and ethical considerations are also discussed to provide transparency and ensure the credibility of the study.

3.1 Research Design

The research design refers to the overall strategy that the researcher chooses to integrate the different components of the study in a coherent and logical way. For this study, a descriptive research design was chosen, which allows for a detailed investigation into the material management strategies applied in the Chinsali-Nakonde road project. This design enabled the researcher to collect data from various sources and analyze how material management practices influence project success.

3.2 Target Population

The target population for this study consisted of key stakeholders involved in the Chinsali-Nakonde road project. These include project managers, construction engineers, material managers, and procurement officers who are directly responsible for material management and logistics. The population also included government officials overseeing infrastructure projects and contractors working on the project.

3.3 Sampling Design

A stratified random sampling technique was used to select participants from the target population. This approach ensures that different groups, such as project managers, procurement officers, and contractors, are proportionately represented in the study. The stratification ensures that each subgroup within the target population is considered, and random selection within each group minimizes bias.

3.4 Sample Size Determination

The sample size was determined using a formula for calculating sample sizes in descriptive studies. The formula takes into account the total population size, the confidence level (typically 95%), and the margin of error (5%). Based on these factors, the sample size was calculated to be sufficient to ensure that the findings are representative and statistically valid. A total of 50 participants were selected for the study, including members from each subgroup within the target population.

3.5 Data Collection Methods

Data for this study were collected using both qualitative and quantitative methods to ensure comprehensive insights. The following method was employed: Surveys/Questionnaire: Structured questionnaires was distributed to selected participants to gather quantitative data on material management practices, challenges faced, and the effectiveness of different strategies.

3.6 Data Analysis

The data collected through observations and questionnaires were analyzed using descriptive statistics to summarize patterns and trends. The qualitative data from interviews were analyzed using thematic analysis, which involved identifying common themes and insights across different responses. Software tools like SPSS were used to assist with the data analysis, ensuring that the results were robust and accurate.

3.7 Triangulation

To ensure the validity and reliability of the findings, triangulation was employed. This approach involves using multiple data sources (surveys, observations, interviews, and document review) and multiple methods (quantitative and qualitative) to cross-check the results. Triangulation helps in minimizing bias, increasing the credibility of the findings, and providing a more comprehensive understanding of the effectiveness of material management strategies.

3.8 Limitations of the Study

While this study provides valuable insights into the effectiveness of material management strategies, it is not without limitations.

Due to the project timeline, it was not possible to collect data over a long period, which may limit the ability to assess long-term effects of material management strategies.

The study is focused solely on the Chinsali-Nakonde road project, which may not fully represent the material management practices in other road construction projects or industries.

Some project documents may not have been available or fully accessible, limiting the ability to obtain complete data on material management practices.

3.9 Ethical Considerations

This study adhered to ethical guidelines to ensure the protection of participants and the integrity of the research process. Key ethical considerations included

1. All participants were informed about the purpose of the study, and their consent was obtained before data collection.
2. Participants' identities and responses were kept confidential, and the data were anonymized to protect their privacy.
3. Participation in the study was entirely voluntary, and participants had the right to withdraw at any time without any consequences.

4. Results/Findings

4.1 Background Characteristics of the Respondents

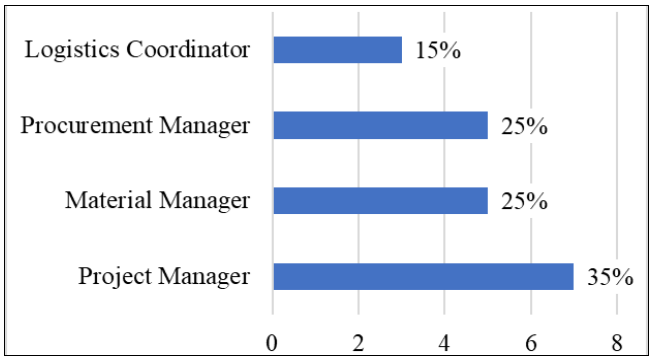

Fig 1: What is your role in the project?

The chart above depicts respondent's responses when they were asked 'What is your role in the project, 35% reported project manager, 25% reported procurement manager, 25% reported material manager, 15% reported logistics coordinator. Results indicate assigned roles of respondents that participated in the study.

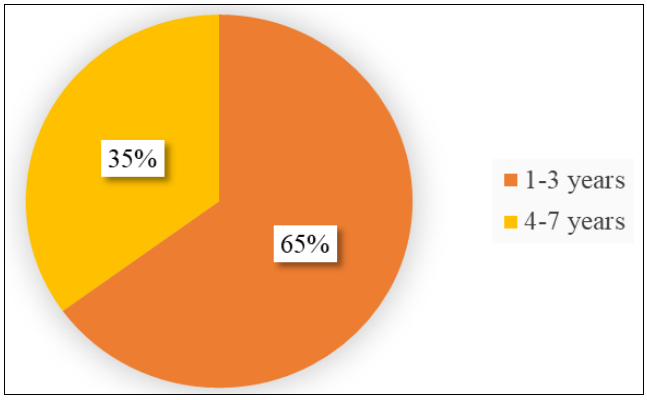

Fig 2: How many years of experience do you have in project management or material management?

The pie chart above displays respondent's responses on 'how many years of experience do you have in project management or material management, 65% of the respondents mentioned 1-3 years, 35% mentioned 4-7 years. The results showed that majority of the respondent's that were in the study, had only 1-3 years of experience in project management/material management.

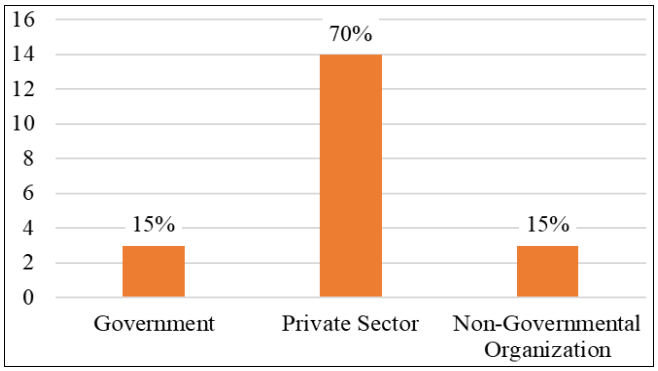

Fig 3: Which organization are you affiliated with for this project?

Results in the chart above displays respondent's responses when they were asked 'Which organization are you affiliated with for this project, 70% reported private sector, 15% reported government, 15% reported 15%. The results of the study concluded that majority of the respondents were affiliated to the private sector than to other sectors.

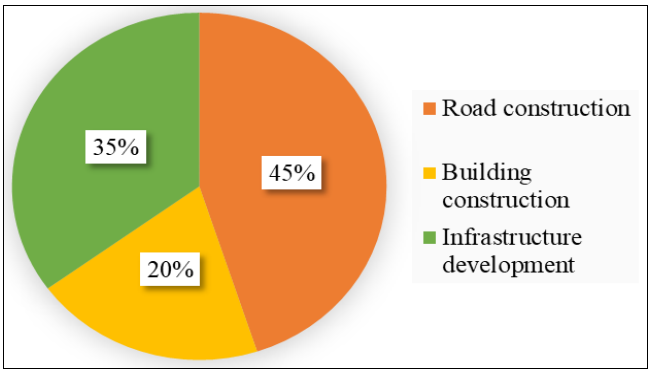

Fig 4: What type of project are you involved with?

The pie chart above displays respondent's responses on 'What type of project are you involved with, 45% mentioned road construction, 35% mentioned infrastructure development, and 20% mentioned building construction.

4.2 How Transportation of Material Management Enhances Project Performance.

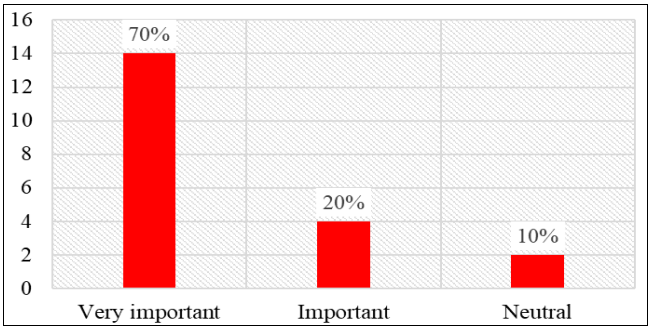

Fig 5: How important is planning in material management for the success of the Chinsali-Nakonde road project?

The study's results showed 70% of the respondents said very important to how important is planning in material management for the success of the Chinsali-Nakonde road project, 20% also confirmed important, and 10% of the respondent said neutral. Results showed majority (70%) of the respondents said the project to be very important.

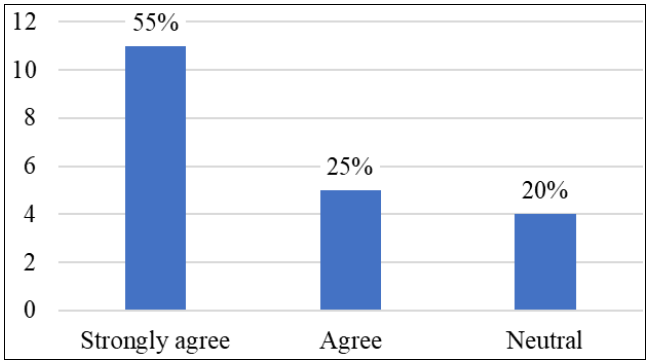

Fig 6: To what extent do you agree with the statement: "A well-prepared material management plan improves project performance"?

The study showed 55% of the respondents said they strongly agreed when they were asked 'to what extent do you agree with the statement: "A well-prepared material management plan improves project performance", 25% just agreed, while 20% were neutral. Indicating that majority of the respondents strongly agreed that "a well-prepared material management plan improves project performance.

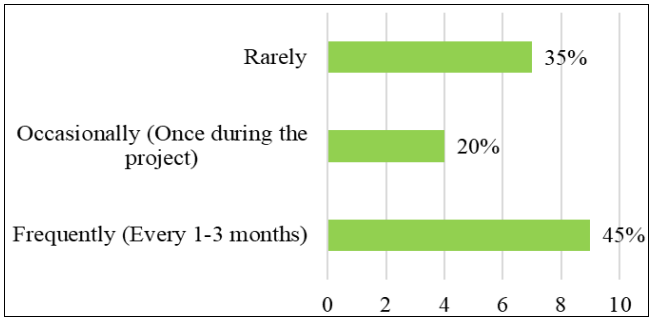

Fig 7: How often are material management plans reviewed and updated during the project?

The chart above displays respondent's responses on 'How often are material management plans reviewed and updated during the project, 45% of the respondents reported frequently (every 1-3 months), 35% reported rarely, 20% reported occasionally (once during the project).

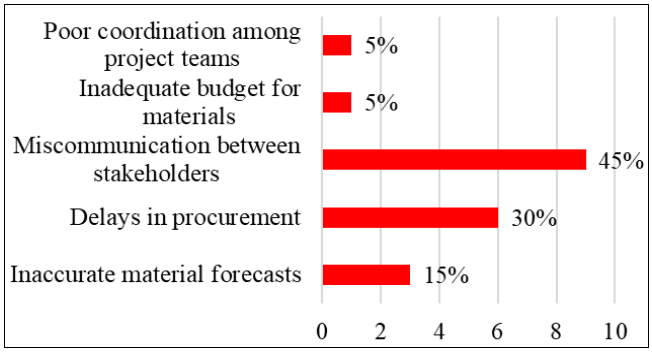

Fig 8: What challenges have you faced with planning in material management on the Chinsali-Nakonde road project?

The chart above displays the responses given by the respondents in the study when they were asked 'What challenges have you faced with planning in material management on the Chinsali-Nakonde road project, 45% mentioned miscommunication between stakeholders, 30% reported delays in procurement, 15% reported inaccurate material forecasts, 5% reported poor coordination among project teams, 5% reported inadequate budget for materials.

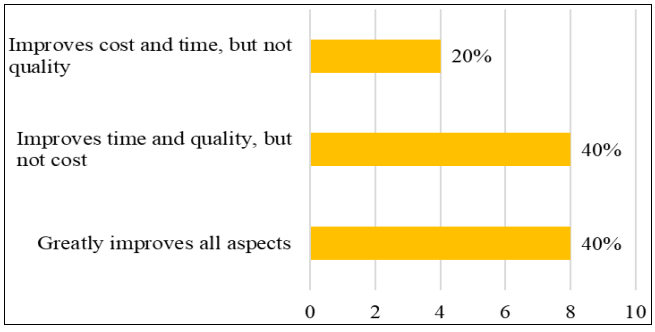

Fig 9: How does effective planning of materials impact the overall project performance, such as cost, time, and quality?

The chart above highlights 'how does effective planning of materials impact the overall project performance, such as cost, time, and quality, 40% respondents said improves time and quality, but not cost, 40% said greatly improves all aspects, 20% said it improves cost and time but not quality. Improves time and quality, but not cost making 40% and greatly improves all aspects making 40% emerged as the results on effective planning of materials.

4.3 How Transportation of Material Management Enhances Project Performance.

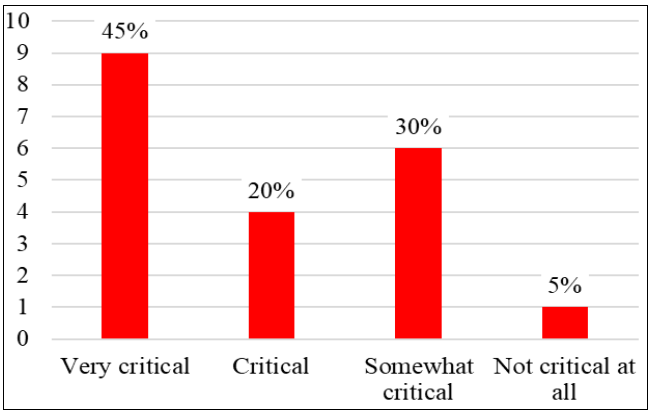

Fig 10: How critical is transportation in material management for the Chinsali-Nakonde road project?

The chart above displays responses on the question' how critical is transportation in material management for the Chinsali-Nakonde road project, 45% of the respondents confirmed it to be very critical, 30% said somewhat critical, 20% just reported critical, while 5% reported not critical at all.

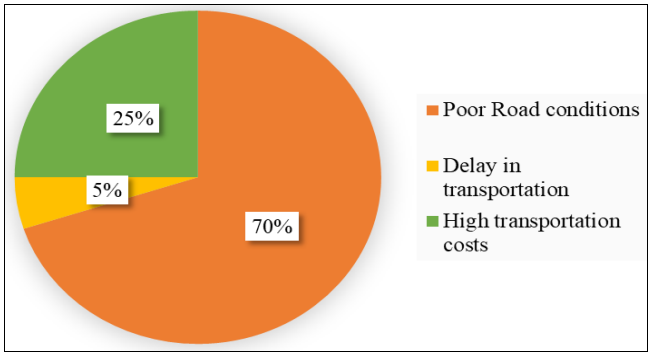

Fig 11: What transportation-related challenges have impacted material management on the project?

Results show respondent's responses on 'What transportation-related challenges have impacted material management on the project, majority (70%) of the respondent's mentioned poor road conditions, 25% mentioned high transportation costs, 5% mentioned delay in transportation.

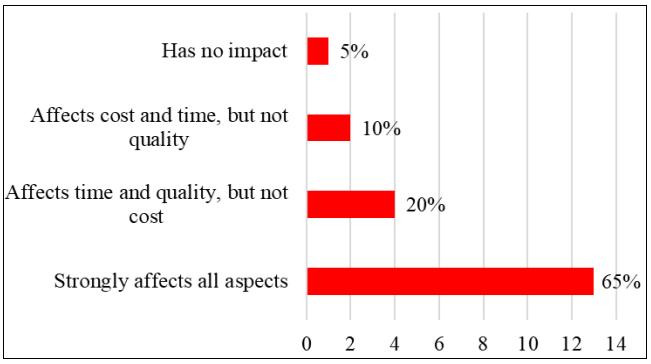

Fig 12: To what extent do you believe that timely transportation of materials affects project performance (e.g., project timeline, cost, and quality)?

The chart above shows responses on the question 'To what extent do you believe that timely transportation of materials affects project performance (e.g., project timeline, cost, and quality), 65% of the respondents said it strongly affects all aspects, 20% said it affects time and quality, but not cost, 10% said it affects cost and time, but not quality.

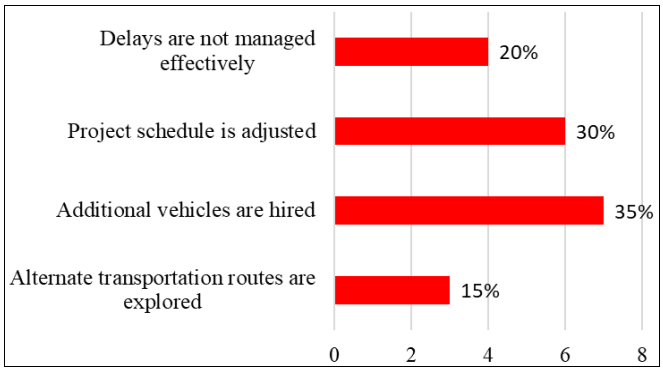

Fig 13: How transportation delays are typically managed on the Chinsali-Nakonde road project?

The study's results on 'How are transportation delays typically managed on the Chinsali-Nakonde road project, 35% of the respondents said additional vehicles are hired, 30% said project schedule is adjusted, 20% said delays are not managed effectively, 15% said alternate transportation routes are explored.

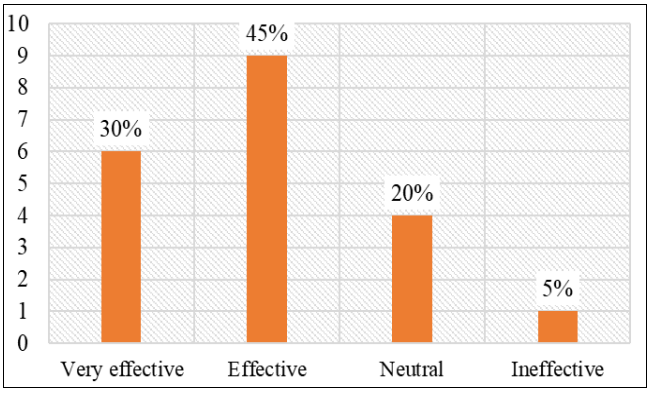

Fig 14: How would you rate the overall transportation system in supporting the timely delivery of materials for the Chinsali-Nakonde road project?

The bar chart above displays respondent's responses on 'How would you rate the overall transportation system in supporting the timely delivery of materials for the Chinsali-Nakonde road project, 45% reported effective, 30% reported very effective, 20% reported neutral, 5% reported ineffective.

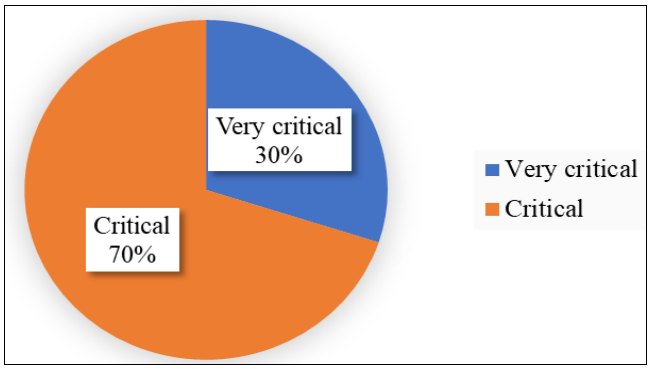

Fig 15: How critical is proper material storage for the Chinsali-Nakonde road project

The pie chart above depicts respondent's responses on 'How critical is proper material storage for the Chinsali-Nakonde road project, 70% who represented the majority reported critical, 30% reported very critical.

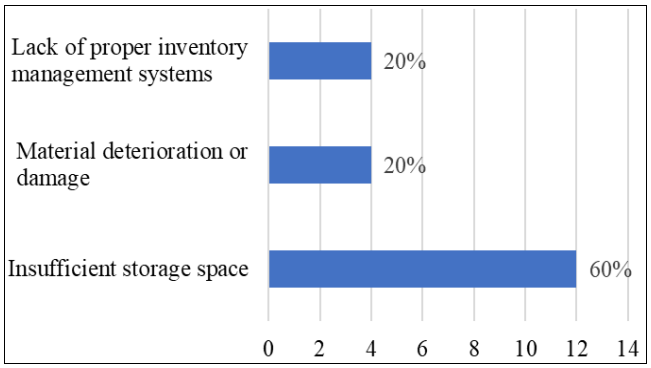

Fig 16: What storage-related challenges have you encountered during the project? (Select all that apply)

The study's results on 'What storage-related challenges have you encountered during the project? (Select all that apply), 60% of the respondents said insufficient storage space, 20% said lack of proper inventory management systems, 20% said material deterioration or damage.

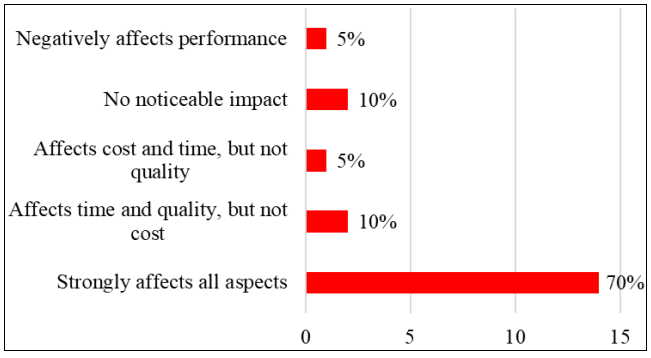

Fig 17: To what extent do you believe proper storage of materials affects project performance in terms of cost, time, and quality?

The column bar chart above displays respondent's responses on 'To what extent do you believe proper storage of materials affects project performance in terms of cost, time,

and quality, 70% said it strongly affects all aspects, 10% said it affects time and quality, but not cost, 10% said no noticeable impact, 5% said it negatively affects performance, 5% said its affects cost and time, but not quality.

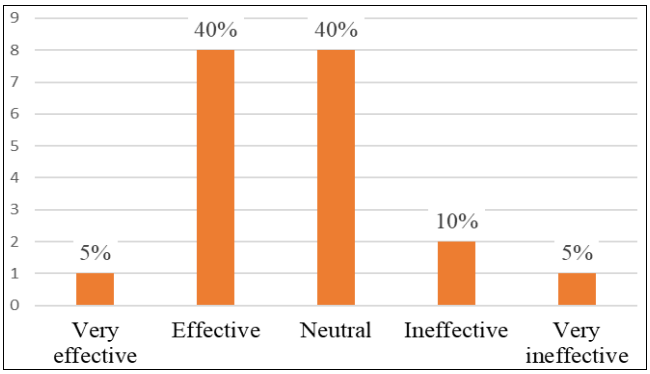

Fig 18: How would you rate the current storage practices for materials on the Chinsali-Nakonde road project?

Results showed 40% of the respondents said effective when they were asked 'How would you rate the current storage practices for materials on the Chinsali-Nakonde road project, 40% said neutral, 10% said ineffective, 5% said very effective, 5% said very ineffective.

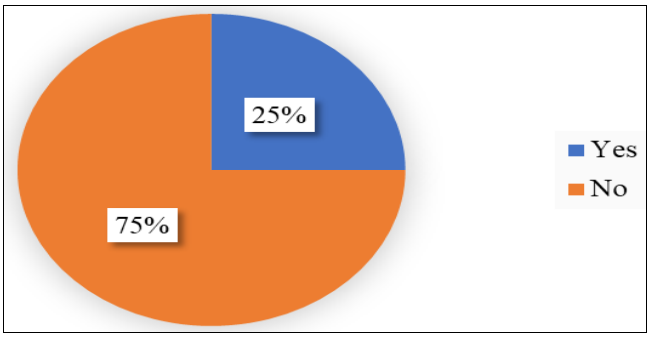

Fig 19: Have you experienced any delays or quality issues as a result of improper material storage on the Chinsali-Nakonde road project?

The pie chart above presents responses from the question '. Have you experienced any delays or quality issues as a result of improper material storage on the Chinsali-Nakonde road project, 75% of the respondents answered no, while 25% answered yes?

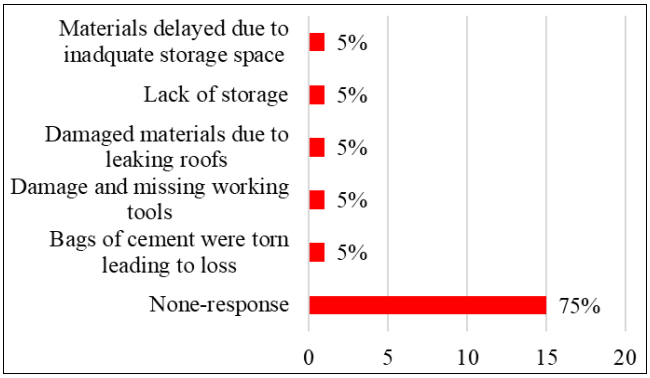

Fig 20: Have you experienced any delays or quality issues as a result of improper material storage on the Chinsali-Nakonde road project?

The results in the chart above were drawn from the question 'Have you experienced any delays or quality issues as a result of improper material storage on the Chinsali-Nakonde road project, 75% of the respondents did not respond to the question, 5% reported materials delayed due to inadequate storage space, 5% reported lack of storage, 5% reported damage materials due to leaking roofs, 5% reported damage and missing working tools, 5% reported bags of cement were torn leading to loss.

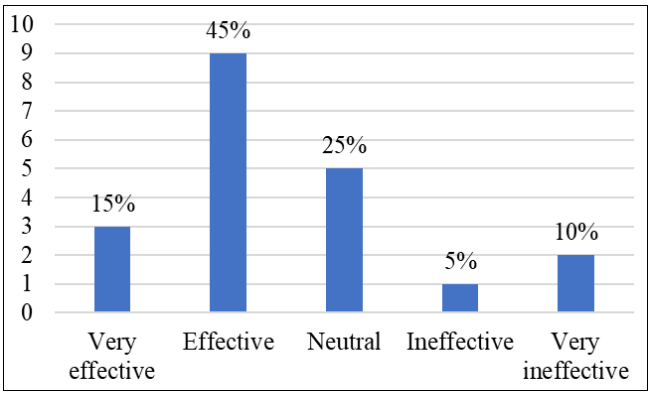

Fig 21: How would you rate the overall effectiveness of material management strategies (planning, transportation, and storage) on the Chinsali-Nakonde road project?

The chart above depicts responses on the question 'How would you rate the overall effectiveness of material management strategies (planning, transportation, and storage) on the Chinsali-Nakonde road project, 45% of the respondents said effective, 25% said neutral, 15% reported very effective, 10% reported very ineffective, 5% reported ineffective.

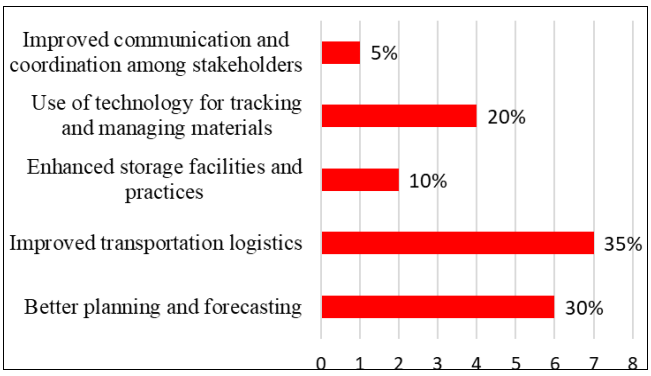

Fig 22: In your opinion, what improvements could be made in material management strategies to enhance project performance on the Chinsali-Nakonde road project?

The chart above displays responses on 'what improvements could be made in material management strategies to enhance project performance on the Chinsali-Nakonde road project, 35% said improved transportation logistics, 30% said better planning and forecasting, 20% said use of technology for tracking and managing materials, 10% said enhanced storage facilities and practices, 5% said improved communication and coordination among stakeholders.

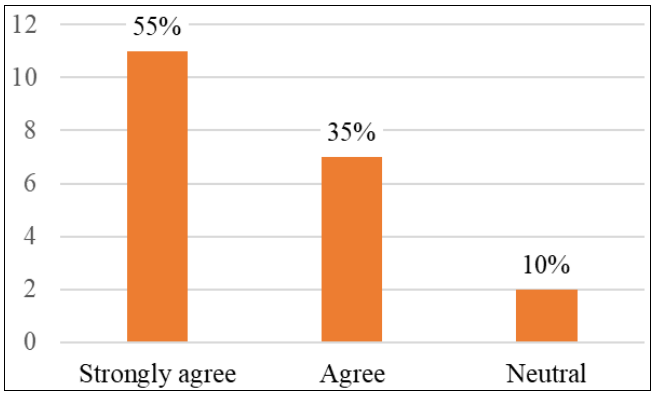

Fig 23: Do you believe that effective material management is directly linked to the overall success of the Chinsali-Nakonde road project.

The study's results showed 55% strongly agreed, 35% just agreed, 10% remained neutral on the question 'Do you believe that effective material management is directly linked to the overall success of the Chinsali-Nakonde road project?

Table 1: Please share any additional comments or suggestions on improving material management strategies for road construction projects like the Chinsali-Nakonde road

suggestions on improving material management strategies for road construction projects	Frequency
Adequate and proper storage	1
Communication	1
Coordination among stakeholders is ideal	1
Coordination among stakeholders is strongly recommended	1
Coordination among stakeholders	1
Enough storage needed	1
Finances should be paid on time	1
Improving material management strategies for road construction	1
Proper communication among stakeholders	1
Proper forecasting of risks to be done to avoid avoidable losses	1
Regular reviews of material management	1
Stakeholders should communicate and cooperate in managing planning	1
Sufficient forecasting	1
Sufficient forecasting to be done as the cost of materials changes from time to time	1
Tracking technologies would enhance and facilitate close monitoring of the transportation materials	1
Total	15

4.4 Discussions

The data collected from respondents provide valuable insights into various aspects of material management, transportation, and storage in the context of the Chinsali-Nakonde road project. The discussion of the findings below synthesizes key patterns and trends observed in the responses, highlighting the critical factors that influence project performance and the challenges faced by the respondents.

4.4.1 Background Characteristics of the Respondents

The respondent pool consisted of professionals holding key roles in project management, procurement, materials, and logistics. The most common role was that of Project Manager (35%), followed by Procurement Manager (25%) and Material Manager (25%), indicating a strong representation from roles that directly influence the material management process.

The experience levels revealed that the majority of respondents (65%) had 1-3 years of experience, with 35% having between 4-7 years. This suggests that while the team may be relatively young in terms of experience, the majority still possess a basic level of exposure to project and material management.

A significant proportion of respondents (70%) were affiliated with the private sector, which may reflect the predominance of private sector involvement in road construction projects in the region. Only 15% were affiliated with the government sector, indicating the limited government presence in the project teams. This is crucial because the private sector's approach to material management may differ in terms of efficiency, resource allocation, and risk management compared to government-run projects.

The types of projects respondents were involved in predominantly revolved around road construction (45%) and infrastructure development (35%), both of which are material-intensive projects that require careful planning, logistics, and transportation to ensure timely completion.

4.4.2 Importance of Planning in Material Management

The majority of respondents (70%) indicated that planning in material management is very important for the success of the Chinsali-Nakonde road project. This aligns with the assertion that proper planning is crucial to mitigating delays and ensuring the project stays on budget and schedule. Effective planning also enhances the efficiency of material procurement, storage, and distribution.

When asked whether a well-prepared material management plan improves project performance, the data showed that 55% strongly agreed, while another 25% agreed, underscoring the critical role planning plays in achieving desired project outcomes. However, the 20% who remained neutral suggest there may be challenges or inconsistencies in the implementation of material management plans, possibly due to unforeseen external factors.

4.4.3 Challenges in Material Management

The challenges faced in material management were varied. The most prominent challenge, highlighted by 45% of respondents, was miscommunication between stakeholders, which can result in delays and confusion, especially when planning and coordination are critical. Delays in procurement (30%) were also significant, often resulting in shortages or stockouts of essential materials that can stall project progress. Other challenges included inaccurate material forecasts (15%), poor coordination among project teams (5%), and inadequate budgets for materials (5%).

These findings point to the need for better communication, forecasting, and budgeting practices to enhance the efficiency of material management. Respondents also emphasized the importance of regular updates to material management plans to adapt to changing project dynamics. However, material management plan reviews were often found to be either rarely (35%) or only occasionally (20%) updated, suggesting a need for more frequent evaluations and updates.

4.4.4 Role of Transportation in Material Management

Transportation was identified as a critical component of material management, with 45% of respondents rating it as *very critical* for the success of the Chinsali-Nakonde road project. This emphasizes the need for reliable transportation

systems that can handle the scale of material movement required for large construction projects.

However, transportation-related challenges were significant, with 70% of respondents citing poor road conditions as a major barrier. This highlights the vulnerability of construction projects to external factors like weather and infrastructure quality, which can severely disrupt material delivery schedules. High transportation costs (25%) and delays in transportation (5%) were also noted as key issues that hinder smooth material flow.

On a more positive note, the overall transportation system was rated effective (45%) by the majority, although 20% felt it was either ineffective or neutral. This indicates that while there is room for improvement, the transportation network largely supports the timely delivery of materials.

4.4.5 Material Storage and Its Impact on Project Performance

The importance of proper material storage was recognized by 70% of respondents, who described it as critical to project success. Storage-related challenges were primarily cantered around insufficient storage space (60%), which can lead to disorganization, damage, and delays in material availability. Other issues included lack of proper inventory management systems (20%) and material deterioration (20%).

The impact of proper storage on project performance was significant, with 70% of respondents indicating that it strongly affects cost, time, and quality. Poor storage practices can lead to material wastage, delays, and ultimately increased costs, as damaged materials may need to be replaced or remanufactured.

The current storage practices were described as effective (40%) or neutral (40%), but there was still a notable portion (10%) who viewed the practices as ineffective. This suggests that while storage management is generally functional, there is room for improvement in optimizing storage space, better inventory control, and reducing material damage.

4.4.6 Overall Effectiveness of Material Management Strategies

In terms of the overall effectiveness of material management strategies (planning, transportation, and storage), 45% of respondents rated it as effective. This implies that, while the strategies in place are not perfect, they are generally achieving the intended goals. However, 25% remained neutral, and 15% considered the strategies very ineffective, indicating dissatisfaction with the implementation of material management processes.

To enhance project performance, respondents suggested several improvements to material management strategies. The most common suggestions included improved transportation logistics (35%), better planning and forecasting (30%), and the use of technology (20%) for tracking and managing materials. These suggestions reflect the evolving demands of modern construction projects, where efficiency and technology integration play a vital role in improving project outcomes.

4.4.7 Link Between Material Management and Project Success

Finally, the majority of respondents (55%) strongly agreed that effective material management is directly linked to the overall success of the Chinsali-Nakonde road project, while 35% just agreed. This consensus underscores the essential role that material management plays in achieving project goals related to time, cost, and quality.

4.5 Conclusion

In conclusion, the study highlights the critical role of material management strategies in ensuring the success of construction projects. By addressing gaps and leveraging strengths in planning, transportation, storage, and purchasing, project managers can enhance efficiency, reduce costs, and achieve better project outcomes. These findings contribute to the broader discourse on sustainable and efficient project management practices, providing a framework for future improvements in material management strategies.

4.6 Recommendations

Based on the findings and discussions, the following recommendations are proposed to improve material management strategies in project management, particularly in the context of large-scale infrastructure projects such as the Chinsali-Nakonde road:

1. Develop Comprehensive Material Management Plans: Project managers should adopt detailed material procurement schedules, integrating anticipated project needs, market trends, and risk assessments.
2. Adopt Advanced Planning Tools: Use project management software to streamline planning, monitor material availability, and predict potential shortages.
3. Incorporate Contingency Plans: Include robust risk management strategies to address unforeseen disruptions, such as supplier delays or material shortages.
4. Strengthen Supplier Coordination: Establish clear communication channels and delivery schedules with suppliers to minimize logistical uncertainties.
5. Adopt Real-Time Tracking Systems: Implement GPS-enabled tracking for materials in transit to monitor progress and address delays promptly.
6. Upgrade Storage Facilities: Construct storage facilities that meet the specific needs of materials, particularly those requiring controlled environments (e.g., temperature or humidity regulation).
7. Implement Inventory Management Systems: Use digital systems to track inventory levels, reduce wastage, and optimize material usage.
8. Foster Long-Term Supplier Relationships: Build partnerships with reliable suppliers to secure consistent quality, competitive prices, and timely delivery.
9. Adopt Bulk Purchasing Policies: Where feasible, purchase materials in bulk during favorable market conditions to reduce costs and ensure material availability.
10. Regularly Monitor Market Trends: Stay updated on market dynamics to negotiate favorable terms and adapt procurement strategies as needed.
11. Promote Collaboration Across Teams: Foster communication and coordination among planning, procurement, logistics, and storage teams to ensure seamless material flow.
12. Conduct Regular Performance Reviews: Periodically assess the effectiveness of material management strategies and make adjustments based on project requirements and feedback.

13. Invest in Training and Capacity Building: Equip project teams with the skills and knowledge needed to implement advanced material management practices effectively.
14. Advocate for Supportive Policies: Engage policymakers to prioritize infrastructure development and regulations that support efficient material transportation and procurement.

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