Influence of Logistics on Material Procurement for Construction Projects in Abuja, Nigeria

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Abstract

Inefficient material procurement due to poor logistics management is one of the substantial causes of time and materials wastes in the construction industry. This study assessed the influence of logistics on material procurement for construction projects in Abuja. Data were obtained from selected construction firms in Abuja using well-structured questionnaire administered on 74 respondents. Mean Item Score (MIS) and Spearman's rank correlation were employed for the analysis of data. It was found that "Competence of procurement officer" and "Quality" were the most critical components required for material procurement (MIS = 4.43 and 4.39 respectively); "Transportation" and "warehousing" were the major factors affecting material procurement (average MIS = 4.29 and 4.23 respectively); relationship between critical components required for material procurement and major logistics factors affecting material procurement was weak, positive and non-significant (R = 14.8%), and "Training of procurement and management staff" and "Managing of relationship with suppliers" were the most effective strategies for reducing cost of material procurement on construction sites (MIS = 4.80 and 4.75 respectively). It was concluded that the influence of logistics on materials procurement is not statistically significant. Procurement officers with good pricing and negotiation skills should therefore be appointed for material procurement.

Keywords: Construction, Logistics, Materials, Procurement, Projects, Sites.

Introduction

The Nigerian construction industry is one of the major contributors to the Gross Domestic Product (GDP) of the country and also a recognised employer of labour (Adewuyi & Odesola, 2015). The construction industry is different from material supplying, manufacturing industry (Subramani *et al.*, 2018). This is because the construction industry deals with so many professionals, tradesmen and experts usually carrying out the bulk of the activities on site with a very high risk of hazard. A construction project depends upon engaging the right people with right skills and equipment that are able to deliver the project on time and on budget. Employing the right materials in the right place at the right time and having the cash flow and capital to procure the labour and materials are equally important (Donyavi1 & Flanagan, 2009). Materials should be obtained at a reasonable cost, and be available for use when needed because the cost of materials represents a large proportion of construction cost. Material in particular covers about 60% of total construction cost (Patil *et al.*, 2013). Thus, managing procurement costs improves chances for reducing the overall project costs. Ordering smaller quantities of material more frequently minimises the locked-up capital in material inventories.

This increases the probability of material shortages and project delays. On the other hand, ordering larger quantities of material less frequently minimises the probability of material shortage and project delays. This increases the cost of locked-up capital in large inventory buffers on-site.

Logistics, with respect to construction activities, is a complex task comprising of several activities including: making a list of required materials, sourcing material vendors, placing orders, arranging for transportation, providing storage space, keeping material inventory and allocating material for use. Tunji-Olayeni *et al.* (2017) reported that challenges arising from poor logistics on construction sites still persist; these include errors and difficulties in ordering materials in small quantities. Efficient logistics on site can enhance overall construction project outcomes. Specifically, it can cut down on time and material wastages: both of which have negative implications for construction cost. Logistics involves planning, implementation and controlling of construction resources in terms of supply, storage, processing and handling. Material procurement consists of recognising, defining and describing the need, investigating and selecting the vendor, ordering materials, receipt and inspection of goods supplied, auditing invoices and closing the order (Ayoade, 2004). Hence, efficient material procurement holds great potentials for significant cost savings for construction projects. An understanding of the components necessary for efficient material procurement can therefore assist project managers in successfully sorting out the material component of projects thereby enhancing overall project outcome.

The construction industry has been described as one of the most wasteful industries. Waste particularly from material stems from inefficient logistics which may result in time and cost overruns. In addition, the rising price of building materials and the ever-increasing cost of construction have become topical in many countries. However, minimising waste emerges from identifying the causes of waste (Amusan *et al.*, 2017). Inefficient material procurement is one of the substantial causes of material and time wastes in the construction industry. However, delays and extra expenses may be incurred if materials required for particular activities are unavailable. In view of this, Adewuyi and Odesola (2015) emphasised that the sluggishness in construction progress can be attributed to poor material procurement system which affects the rate of housing delivery in Nigeria. This constitutes the problem which necessitates this study. Therefore, this study is centred at providing a comprehensive investigation into the various logistics components which are necessary for effective materials procurement.

In order to solve the identified problem of the research, this study assessed the influence of logistics on material procurement for construction projects in Abuja with a view to suggesting strategies for reducing cost of materials procurement. To achieve this aim, the research identified the critical components required for successful material procurement on construction sites; examined the major logistics factors affecting materials procurement on construction sites; determined the influence of logistics factors on material procurement on construction sites; and proposed strategies for reducing cost of material procurement on construction sites.

Literature Review

This section undertakes a critical review of literature related to the themes of the aim and objectives of the study. In view of this, the section identifies the components required for material procurement; major logistics factors affecting material procurement on construction sites; influence of logistics on material procurement; and strategies for reducing cost of material procurement on construction sites.

Components Required for Material Procurement

Isah (2012) identified the key components necessary for a successful material

procurement as source management, quantity, quality, vendor reputation, time, competence of procurement officer and price. According to Isah (2012), source management is faced with a number of decisions concerning the source of the firm's raw materials and components. The obvious strategy is one which maximizes the other components, obtaining supplies in the quantity and quality required, when they are needed, and an acceptable price. In achieving these aims, management must decide whether to produce their own materials and components or buy them from other manufacturer; and if the latter, whether to opt for a single supplier or buy from a number of different suppliers.

As far as quantity is concerned, the major purchasing decision is how much to order at any a time. This is a function of cost, storage capacity, and the nature of the production system (Isah, 2012). Therefore, before procuring of material the quantity of material as to be determined this is done by the officer in charge of material procurement. The schedule of work plays a vital role in determining the quantity required at a particular period of time.

Stressing further on the components required for material procurement, Isah (2012) reported that quality is meeting or exceeding the expectations of the contractor/client by achieving better efficiency, quality and productivity. Acquiring the highest value of a product at lower cost will improve the performance of a company. Thus, the quality of incoming construction materials as components is a vital ingredient in the quality control function. The purchasing department or the procurement officer is usually responsible for the acceptance sampling and inspection and inspection of incoming materials.

According to others Aretoulis *et al*. (2010), vendor reputation is very vital in material procurement, vendor inquiry and assessment usually come before the actual materials purchase. The capacity inquiry is submitted by vendors whose technical and commercial capacities are to be further evaluated in view of previous ability and performance to cater for particular project needs. Depending on the project types and construction techniques, evaluation of the vendor could be based on several criteria. This includes the tendency of participating in a pull or push delivery system, volume capacity, the supply of prefabricated materials, location, responsible sourcing, among.

The timing of a purchase is like order quantity, a function of the needs of the production system, storage capacity and price (Isah, 2012). The most common way in which the contractor gets most of his projects is by hard bid. Because of the competitive nature of hard bidding, the contractor needs to obtain materials and subcontractor's services at the lowest cost possible. Usually, the contractors request bids from suppliers and subcontractors in order to get the lowest prices possible for their services and products. Ordering materials very late may cause disruption to work progress on site and delay the project and ordering materials too early may lead to build-up unnecessary inventories or stocks.

According to Isah (2012), price is one the fundamental criteria required for material procurement. This is may be due to the fact that the contractors believe that they can get lowest prices by competitive bidding. However, using competitive bidding to select the suppliers will make the suppliers to reduce their profit to the minimum in order to win the contract. This in turn may create adversarial relationships between them during the course of project implementation and consequently affect the project's success. The goal of every contractor is to procure materials at the lowest price.

According to Isah (2012), the procurement officer should be aware of potential suppliers by reviewing trade journal, technical, publication and directives. He should also endeavour to attend trade fairs and keep in contact with professional colleagues. Also, for effective material management, he should keep personal contact and touch with key figures on the supply companies.

In conclusion, Arijeloye and Akinradewo (2016) who also identified similar components required for material procurement, recommended that these components are very effective towards addressing the problem militating against materials management.

Major Logistics Factors Affecting Material Procurement on Construction Sites

According to Fulford and Standing (2014) and Tunji-Olayeni *et al*. (2017), there are some specific logistics factors which have been found to have effect on material procurement for construction projects. These factors include: *Late delivery of materials and components; Inability to forecast activity period with accuracy; Inaccuracies in delivery; Transportation; Warehousing; and Increase of waiting time between activities.*

According to Fulford and Standing (2014), late delivery of materials and components could be as a result of several factors including people, policies, poor road network and procedures. The location and terrain of the construction site entrance affects the delivery of construction materials it could make it particularly difficult. In order to address the problem of inability to forecast activity period with accuracy, Fulford and Standing (2014) reported that many procurement officers will prefer to procure materials in bulk so as to take advantage of sales discounts. However, material procurement for construction projects requires that procurement officers accurately forecast activity periods on site this could be hindered by project type and changes in programme schedule.

Inaccuracies in delivery can result in cost and time wastages. In a situation where a purchasing manager orders for a material and a different material is delivered, time would have been wasted in delivering the wrong material. Where large volume of material is delivered inaccurately, great amount of time is wasted in correcting the inaccuracies thereby affecting scheduled project completion time this could be caused by wrong material specification, taking off error and efficient communication with suppliers (Fulford & Standing, 2014).

Most of the materials used on construction sites are not manufactured on site but are procured from other places and transported to site. In view of this, Fulford and Standing (2014) emphasized that in construction, transportation enhances the flow of material from the supplier or manufacturer to the construction site. It is the physical distribution channel which connects various important geographically dispersed operating components together within the logistics system (Tunji-Olayeni *et al*., 2017).

Materials that are procured in large quantities without complying with the production needs on site will result in waste of resources during stocking, handling and transporting (Agapiou *et al.*, 1998). However, construction contract must make provision for temporary storage because of some uncertainty in the period between ordering and receiving materials. Storing material on site can also have some negative impact on project outcomes (Johnson, 2009). While also exasperating the issue of security of materials is very common in storage of material (Berg & Hinze, 2005). In the light of these studies, Fulford and Standing (2014) asserted that adequate storage warehouse plays a crucial role in the procurement of material.

Construction activities are usually done in stages. Each stage depends on the completion of previous activity. Charging is time is the time required between material ordering with the arrival of material in order to minimize the cost opportunity loss. Scarcity of material also increases the waiting time. Late completion in an activity can affect start time of the next activity. In the light of this, Tunji-Olayeni *et al*. (2017) reported that adequate activity planning is required for efficient material logistics on site.

Arijeloye and Akinradewo (2016), identified improper construction materials management as the most significant factor affecting the general performance of construction projects in respect to construction time, quality, cost and overall construction productivity. In the light of this, Arijeloye and Akinradewo (2016) reported further that late delivery of construction materials, unavailability of materials before commencement of construction work, and the long distance of materials from the work location are the principal causes of materials-related problems on construction sites. Out of all the logistics factors affecting the procurement of materials management on construction sites, the most critical according to Tunji-Olayeni *et al*. (2017) are: late delivery of materials, inability to forecast activity period with accuracy, delivery inaccuracies, transportation challenge, increased waiting time and supply of poor-quality materials.

Influence of Logistics on Material Procurement

The construction industry is arguably one of the least integrated sectors of the global economy, notwithstanding its significance in driving other sectors (Fulford & Standing, 2014). According to Vrijhoef and Koskela (2000), the fragmented nature of the construction activities, as well as peculiar nature of every project, is partly responsible for the one-off approach to materials procurement, with the repeated reconfiguration of materials supply team and project organisation. This has resulted in a large quantity of waste, and several other problems, that characterized the materials supply chain in the construction industry (Vrijhoef & Koskela, 2000). In addition, Fulford and Standing (2014); Tunji-Olayeni *et al*. (2017); and Shitaw (2021) reported that most of the materials used on construction sites are not manufactured on site but are procured from other places and transported to site. In view of this, Fulford and Standing (2014) emphasized that in construction, transportation enhances the flow of material from the supplier or manufacturer to the construction site, while Tunji-Olayeni *et al*. (2017) stated that it is the physical distribution channel which connects various important geographically dispersed operating components together within the logistics system. Therefore, these past studies have confirmed that logistics management has significant effect on material procurement.

Strategies for Reducing Cost of Material Procurement on Construction Sites

Procurement in sustainable building construction has over the years, been translated to a strategy for cutting production cost, improving building quality and enhancing procurement efficiency (Sobhani *et al.,* 2014). The initiation of a viable procurement strategy is a reliable approach to attaining construction project success. Construction materials procurement strategies focuses on the ability of a construction company to satisfy the expectations of its clients without incurring time and cost over-runs during construction. Despite the general conception that the process of materials procurement is time-consuming, it is essential to bear in mind that this process remains the most potent avenue in reducing construction cost (Rajeh *et al.*, 2014). Based on the findings of these studies, Arijeloye and Akinradewo (2016) reported that in order to achieve good materials management on building project, the following areas have to be taken very seriously: Training of management and other staff, Inventory control of materials on site, and Ensuring proper planning, monitoring and control. To achieve these, Arijeloye and Akinradewo (2016) recommended the following effective management of building projects which includes: Management, supervision and administration of sites, Provision of adequate storage of materials, Proper usage of materials, Materials schedule for the contract on hand, Materials delivery, Provision and accessibility site layout, Attention to weather conditions. Therefore, Arijeloye and Akinradewo (2016) revealed that for effective materials management, the

most important measures to be implemented include adequate management and supervision; it shows that administration of sites was the best in respect to conditions for achieving good materials management.

In the light of the above, Ajayi *et al.* (2017) reported that there are four broad measures that are requisite for reducing waste through materials procurement processes and these are: (i) suppliers' attributes and commitment, (ii) materials purchase management, (iii) materials delivery management, and (iv) design compliant procurement. Ajayi *et al.* (2017) stressed further that materials procurement in defiance of design is a major cause of under/over ordering, or what could be generally termed as inaccurate ordering. It is therefore important that materials take-off is accurately done in preparation for actual materials purchase. This is then expected to be followed up by materials ordering that is devoid of over or under ordering. In addition to the four broad measures that are requisite for reducing waste through materials procurement processes, Ajayi *et al.* (2017) also identified five critical procurement measures for waste mitigation. Ajayi *et al.* (2017) referred these measures as the top-rated strategies for preventing waste through materials procurement and logistics. These are measures: Commitment to Take Back Scheme; Procurement of Waste Efficient Materials/Technology; Use of Minimal Packaging; Use of Just in Time (JIT) Delivery System; and Prevention of Over Ordering.

In the contribution of Shitaw (2021) the following strategies for reducing the cost of material procurement on construction sites were identified: Train workers about how to handle and install the material; Training of Procurement and management staff; Accurate inventory control; Employ material waste management officer; Use software for material planning and scheduling; and improve the coordination among stakeholders. Shitaw (2021) revealed that these strategies are very effective in the reduction of the cost of material procurement on construction sites.

Research Methodology

The study chose Abuja as the study area due to the fact that it is the capital city of Nigeria where both indigenous and multinational construction firms execute most of their projects (Kadiri *et al*., 2014). In addition to this, a reasonable number of construction activities take place in Abuja. This was due to the fact that Abuja experiences rapid population increase and new developmental projects daily as a result of rapid urbanisation and rural-urban migration. In view of this, constant increase in demand for shelter for both residential and commercial purposes is experienced. Figure 1 is a map of Nigeria showing the strategic and centrally placed location of Abuja as the Federal Capital City of the country. Figure 2 is a map of Abuja showing the six Area Councils across which construction firms are distributed.

Figure 1: Map of Nigeria showing the location of Abuja (Federal Capital Territory) in Nigeria (Coordinates: 8°50′N 7°10′E)
Source: The Free Encyclopedia (2020)

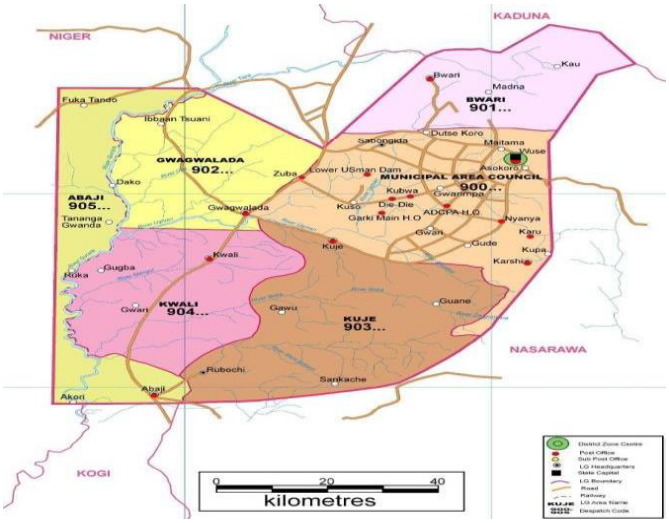

Figure 2: Map of Abuja showing six Area Councils
Source: Ozioma *et al.* (2017)

This study employed the quantitative research approach. The collection of data was done with the aid of well-structured questionnaire. The population comprised 289 construction firms registered by Federal Inland Revenue Services (FIRS) in Abuja. The sample size for this study was determined by using the Kish (1965) Sample Size Table (+ or – 5% precision level). This gives a sample size of 74. In the light of this, 74 copies of questionnaire were administered to the targeted construction firms. The study adopted the simple random sampling technique for the selection of the 74 construction firms. For the purpose of the field work/data collection, each of these firms was represented by either a site manager, quantity surveyor or the officer in-charge of material procurement. This is because these professionals are the relevant respondents required for the study.

The questionnaire was divided into 5 sections (A - E); these sections captured the objectives of the study. Section A considered the general information of the respondents while Sections B – E respectively addressed the objectives of the study. The questionnaire was designed on a five-point Likert's Scale format. The descriptive method of analysis was adopted to analyse the data collected from questionnaire using tools such as Mean Item Score (MIS) and Spearman Rank Correlation analysis. The decision rule

adopted for the MIS analyses are summarised in Table 1.

Table 1: Decision Rule for Data Analysis

Scale	Cut-Off Point	Interpretation			
	MIS	***Level of Importance***	***Level of Significance***	***Level of Effectiveness***	***Level of Requirement***
5	4.10 - 5.00	Very Important	Very Significant	Very Effective	Very Required
4	3.10 - 4.00	Important	Significant	Effective	Required
3	2.10 - 3.00	Fairly Important	Fairly Significant	Fairly Effective	Fairly Required
2	2.10 - 2.00	Less Important	Less Significant	Less Effective	Less Required
1	0.00 - 2.00	Least Important	Least Significant	Least Effective	Least Required

Source: Adapted and Modified from Shittu *et al.* (2015)

Spearman Rank Correlation

This a non-parametric test that is used to measure the degree of association between two variables. The following (equation 1) is used to calculate the spearman rank correlation.

$$\rho = 1 - \frac{6\sum_i^{d^2}}{n(n^2-1)} \text{---------- (1)}$$

ρ = spearman rank correlation
di = the difference between the ranks of corresponding variables
n = number of observation

P test

The decision rule here states that:

- If P value is < 0.05 significance level then relationship is significant
- If P value is > 0.05 significance level then relationship is not significant

Coefficient of correlation (R)

The decision rule here states that:

- If R ≥ 50% then Correlation is strong.
- If R < 50% then Correlation is weak.

Results and Discussion

Response Rate

Copies of questionnaire correctly completed and deemed good for analysis were 56 out of the 74 administered copies and this represented 75.67% response rate. Others are Kheni (2008) and Ikpe (2009) with response rates of 15.42%, 32.42% and 15.8% respectively. In addition, 15.72% and 49.37% were the response rates in the studies of Agumba and Haupt and Shittu (2016) respectively. This justifies that the response rate in this study is adequate. All these studies adopted the survey research approach and for construction site activities. In addition to these, the respondents for the studies in question are also professionals whose opinions were sought with the use of structured questionnaire.

Critical Components Required for Material Procurement on Construction Projects

This section presents and discusses the MIS results of the 7 identified critical components required for material procurement on construction sites. The MIS results are presented in Table 2.

Table 2: Critical Components Required for Material Procurement

S/N	Components required for material procurement	MIS	RANK	Decision
1.	Competence of Procurement Officer	4.43	1st	Very Required
2.	Quality	4.39	2nd	Very Required
3.	Price	4.36	3rd	Very Required
4.	Quantity	4.07	4th	Required
5.	Vendor reputation	3.84	5th	Required
6.	Source management	3.68	6th	Required
7.	Waiting time	3.23	7th	Required
	Average	***4.00***		***Required***

Source: Researchers' Field Survey (2021)

Table 2 shows that "Competence of procurement officer" is the most critical component required for material procurement with the MIS of 4.43, followed by "Quality" with the MIS of 4.39, next is "Price" which was ranked 3rd with the MIS of 4.36, 4th is "Quantity" with the MIS of 4.07, 5th in line is "Vendor reputation" with MIS of 3.84, followed by "Source management" with MIS of 3.68, and finally "Waiting time" is ranked lowest with the MIS of 3.23. On the average, all the identified Components are required for material procurement in construction projects in Abuja (average MIS = 4.00).

The findings here are in line with the findings of Isah (2012) where it was revealed that for effective material management, a procurement officer should be competent enough to keep personal contact and touch with key figures on the supply companies, and price is one the fundamental criteria required for material procurement. It was also revealed that the quality of incoming construction materials as components is a vital ingredient in the quality control function (Isah, 2012). Arijeloye and Akinradewo (2016) who also identified similar components required for material procurement also supported the finding of this study by reporting that these components are very effective towards addressing the problem militating against materials management. Shitaw (2021) also supported the finding of this study by identifying Train workers about how to handle and install the material; Training of Procurement and management staff; Accurate inventory control; Employ material waste management officer; Use software for material planning and scheduling; and Improve the coordination among stakeholders as the most effective strategies for reducing the cost of material procurement on construction sites. In addition, Shitaw (2021) also stressed further that these strategies are very effective in the reduction of the cost of material procurement on construction sites.

Major Logistics Factors Affecting Material Procurement on Construction Projects

The MIS results of the six (6) major logistics factors affecting material procurement on construction projects identified in the study presented in Tables 3.

Level of significance of transportation on material procurement

This section shows (Table 3) and discusses the MIS results of the identified level of significance of transportation on material procurement.

Table 3: Significance of Major Logistics Factors Affecting Material Procurement on Construction Projects

A	Transportation	MIS	Rank	Decision
1	Cost of transportation	4.71	1st	Very Significant
2	Location of the site entrance makes delivery of material difficult	4.25	2nd	Very Significant
3	Damage of materials during transportation	4.23	3rd	Very Significant
4	Political issue/Transport strike	3.95	4th	Significant
	Average MIS	***4.29***		***Very Significant***
B	**Late of delivery materials**	**MIS**	**Rank**	**Decision**
1	Inefficient communication with supplier	4.52	1st	Very Significant
2	Delay in approval	4.27	2nd	Very Significant
3	Poor road network	3.86	3rd	Significant
4	Excessive paperwork	3.79	4th	Significant
	Average MIS	***4.11***		***Very Significant***
C	**Warehousing**	**MIS**	**Rank**	**Decision**
1	Insufficient storage space	4.52	1st	Very Significant
2	Difficulty to coordinate the storage of material in line with the programme	3.88	3rd	Significant
3	Difficulty to provide safe and secure storage of material	4.3	2nd	Significant
	Average MIS	***4.23***		***Significant***
D	**Delivery inaccuracies**	**MIS**	**Rank**	**Decision**
1	Poor communication with supplier	4.14	1st	Very Significant
2	Taking off error	3.64	3rd	Significant
3	Wrong Material specification /quantity	3.84	2nd	Significant
	Average MIS	***3.87***		***Significant***
E	**Increase waiting time between activities**	**MIS**	**Rank**	**Decision**
1	Resource availability/lack of resource	4.09	1st	Significant
2	Too many variation	3.86	2nd	Significant
3	Degree of complexity	3.85	3rd	Significant
	Average MIS	***3.97***		***Significant***
F	**Inability to forecast activity period with accuracy**	**MIS**	**Rank**	**Decision**
1	Material procured without planning	4.14	1st	Very Significant
2	Project type and nature	4.14	1st	Very Significant
3	Changes in the work schedule/work programme	4.00	3rd	Significant
	Average MIS	***4.14***		***Very Significant***
G	**Overall Influence of Major Logistics Factors**	**MIS**	**Rank**	**Decision**
1	Transportation	4.29	1st	Very Significant
2	Warehousing	4.23	2nd	Very Significant
3	Inability to forecast activity period with accuracy	4.14	3rd	Very Significant
4	Late delivery of material	4.11	4th	Very Significant
5	Increase waiting time between activities	3.97	5th	Significant
6	Delivery inaccuracies	3.87	6th	Significant
	Average MIS	***4.10***		***Very Significant***

Source: Researchers' Field Survey (2021)

Table 3A revealed the level of significance of transportation on material procurement on construction sites. It can be seen that "cost of transportation" is the most significant with the MIS of 4.71, next in line is "location of the site entrance makes delivery of material difficult" with the MIS of 4.25, "damage of materials during transportation" is 3rd in line with MIS of 4.23, and finally "political issue/

transportation strike" is least significant with the MIS of 3.95. Averagely, all the identified transportation factors are very significant (average MIS = 4.29). Table 3B summarised the MIS results of the identified level of significance of the factors causing the late delivery on material procurement. It was revealed that "Inefficient communication with supplier" is the most significant with the MIS of 4.64, next in line is "location of the site entrance makes delivery of material difficult" with the MIS of 4.25, "damage of materials during transportation" is 3rd in line with MIS of 4.23, and finally "political issue/ transportation strike" is least significant with the MIS of 3.95. Averagely, all the identified "Late of delivery materials" factors are very significant (average MIS = 4.31).

Table 3C gave a summary of the MIS results on the identified level of significance of warehousing on material procurement. It was shown that "Insufficient storage space" is ranked the most significant with the MIS of 4.52, next in line is "Difficulty to provide safe and secure storage of material" with the MIS of 4.25, and finally "difficulty to coordinate the storage of material in line with the programme" is least significant with the MIS of 3.95. On the average, all the factors identified under warehousing on material procurement on construction sites are significant (average MIS = 4.23). Table 3D shows a summary of the MIS results of the identified level of significance of delivery inaccuracies on material procurement. From Table 3D, it was revealed that "Poor communication with supplier" was ranked the most significant factor of delivery inaccuracies affecting material procurement on construction sites with the MIS of 4.14, next in line is "Wrong Material specification /quantity" with the MIS of 3.84, and finally "Taking off error" is least significant with the MIS of 3.95. On the average, all the factors identified under delivery inaccuracies are significant (average MIS = 3.87).

Table 3E showed the level of significance of increase in waiting time between activities on material procurement on construction sites. It can be seen that "Resource availability/lack of resource" is ranked the most significant with the MIS of 4.09, next in line is "Too many variation" with the MIS of 3.86, and finally "Degree of complexity" is least significant with the MIS of 3.85. Averagely, all the factors identified under increase waiting time between activities are significant (average MIS = 3.97). Table 3F revealed that all the factors identified under "Inability to forecast activity period with accuracy" are significant. These factors are "Material procured without planning"; "Project type and nature" and "changes in the work schedule/work programme" with MIS of 4.14, 4.14 and 4.00 respectively. The average MIS for these factors is 4.14 also indicating that the factors under "Inability to forecast activity period with accuracy" are very significant.

Table 3G showed the overall MIS results of the major logistics factors affecting material procurement on construction. The average MIS values observed in Table 3G ranged from 3.87 - 4.29. "Transportation", "Warehousing", "Inability to forecast activity period with accuracy", and "Late delivery of material" are the most significant logistics factors affecting material procurement on construction site with the average MIS of 4.29, 4.23, 4.14 and 4.11 respectively. While "Increase waiting time between activities" and "Delivery inaccuracies" are of lesser significance with the average MIS of 3.97 and 3.87 respectively. On the average, the major logistics factors affecting material procurement on sites in Abuja are very significant (average MIS = 4.10).

Findings reported here agree with the works of Agapiou *et al.* (1998), Fulford and Standing (2014) and Tunji-Olayeni *et al.* (2017) where it was discovered that in construction, transportation enhances the flow of material from the supplier or manufacturer to the construction site; and materials that are procured in large quantities without complying with the production needs on site will result in waste of resources during stocking, handling and

transporting. In addition to this, the study of Arijeloye and Akinradewo (2016) also discovered that late delivery of construction materials, unavailability of materials before commencement of construction work, and the long distance of materials from the work location are the principal causes of materials-related problems on construction sites in agreement with the findings of this study. In addition, Tunji-Olayeni *et al*. (2017) reported that out of all the logistics factors affecting the procurement of materials management on construction sites, the most critical are: late delivery of materials, inability to forecast activity period with accuracy, delivery inaccuracies, transportation challenge, increased waiting time and supply of poor-quality materials. Finally, Arijeloye and Akinradewo (2016), identified improper construction materials management as the most significant factor affecting the general performance of construction projects in respect to construction time, quality, cost and overall construction productivity.

Influence of the Major Logistics Factors on Material Procurement

Analysis was carried out using the Spearman's Rank Correlation in order to determine the influence of the major logistics factors on material procurement. The results of this analysis are summarised in Table 4. It was observed from Table 4 that there exists a weak, positive and statistically non-significant relationship between "Critical components required for material procurement" and "Major logistics factors affecting material procurement". The correlation coefficient (R value) observed was 14.80% indicating weak degree of association between the variables. The positive correlation observed between the variables indicates a tendency that an increase in the major logistics factor will lead to an increase in the critical components required for material procurement and vice versa. The probability (p) value of 0.278 observed was greater than 0.05. The finding of this study disagrees with the findings of Tunji-Olayeni *et al*. (2017) and Shitaw (2021). Tunji-Olayeni *et al*. (2017) revealed that logistics management has significant effect on material procurement. It was also discovered by Shitaw (2021) that logistics management is very significant towards the reduction of the cost of material procurement on construction sites. In addition, Fulford and Standing (2014); Tunji-Olayeni *et al*. (2017); and Shitaw (2021) reported that most of the materials used on construction sites are not manufactured on site but are procured from other places and transported to site. In view of this, Fulford and Standing (2014) emphasized that in construction, transportation enhances the flow of material from the supplier or manufacturer to the construction site, while Tunji-Olayeni *et al*. (2017) stated that it is the physical distribution channel which connects various important geographically dispersed operating components together within the logistics system.

Table 4: Results of Spearman's Rank Correlation Analysis

Analysis No.	Variables		Observations		Inferences	
	X_1	X_2	R (%)	P_{value}	Strength of Relationship	Remark
1	Critical Components Required for Material Procurement	Major Logistics Factors Affecting Material Procurement	14.80 (0.148)	0.278	Weak	NS

Source: Researchers' Field Survey (2021)

KEY:
NS = Not Significant

All these findings revealed that logistics management has significant effect on material procurement as opposed to the finding of this study.

Strategies for Reducing Cost of Material Procurement on Construction Sites

This section presents and discusses the MIS results of the 9 identified critical components required for material procurement on construction sites. The MIS results are presented in Table 5.

From Table 5, nine (9) strategies have been identified for reducing cost of material procurement on construction sites. The MIS values range between 4.80 and 4.75, indicating that all the strategies are very effective. On the average, the identified strategies for reducing the cost of procurement on construction sites have the MIS of 4.58, also implying that the strategies are very effective. The studies of Sobhani *et al.* (2014) and Rajeh *et al.* (2014) which revealed that the initiation of a viable procurement strategy is a reliable approach to attaining construction project success, and it is essential to bear in mind that this process remains the most potent avenue in reducing construction cost are in line with the outcome reported in this section for this study.

Furthermore, Arijeloye and Akinradewo (2016) revealed that for effective materials management, the most important measures to be implemented include adequate management and supervision; it shows that administration of sites was the best in respect to conditions for achieving good materials management. Finally, Shitaw (2021) revealed that Train workers about how to handle and install the material; Training of Procurement and management staff; Accurate inventory control; Employ material waste management officer; Use software for material planning and scheduling; and Improve the coordination among stakeholders are very effective in the reduction of the cost of material procurement on construction sites.

Conclusion and Recommendations

The study identified the problem of inefficient material procurement due to poor logistics management is one of the substantial causes of time and materials wastes in the construction industry. To address this problem, the study assessed the influence of logistics on material procurement for construction projects in Abuja. To achieve this aim, the data were collected through structured questionnaire from 74 respondents of selected construction firms in Abuja using simple random sampling technique. The data collected were analysed with the use of Mean Item Score and Spearman's rank correlation analysis.

Table 5: Strategies for reducing cost of material procurement on construction sites

S/N	Strategies for reducing cost of material procurement	MIS	Rank	Decision
1	Training of Procurement and management staff	4.80	1st	Very Effective
2	Managing of relationship with suppliers	4.75	2nd	Very Effective
3	Electronic materials Procurement	4.65	3rd	Very Effective
4	Selection of competent vendor	4.65	3rd	Very Effective
5	Provision good road and accessibility	4.55	5th	Very Effective
6	Materials schedule for the contract on hand	4.50	6th	Very Effective
7	Economic order quantity of materials (EOQ)	4.50	7th	Very Effective
8	Just-in-time (JIT)	4.45	8th	Very Effective
9	Provision of adequate storage for materials	4.40	9th	Very Effective
	Average RII	***4.58***		***Very Effective***

Source: Researchers' Field Survey (2021)

Findings from the results of data analysis carried out led to the conclusion stated in this section.

It was revealed that that "Competence of procurement officer" and "Quality" are the most critical components required for material procurement. all the identified Components fare required for material procurement in construction projects in Abuja. Transportation" and "warehousing" are the most significant factors affecting material procurement. All the major logistics factors affecting material procurement on sites in Abuja are very significant. The relationship between the critical components required for material procurement and major logistics factors affecting material procurement is weak, positive and statistically non-significant. "Training of procurement and management staff" and "Managing of relationship with suppliers" are the most effective strategies for reducing the cost of material procurement on construction sites. All the strategies for reducing the cost of procurement on construction sites in Abuja are very effective It can therefore be concluded that the influence of logistics on materials procurement is statistically not significant. However, there is a tendency for improvement in the implementation of effective logistics management to bring about effective material procurement.

In view of the findings and conclusion of this study, vital recommendations are made in this section. Competent procurement officers with good pricing and negotiation skills should be appointed for material procurement on construction sites. Construction firms should focus more on proper communication with suppliers. This will lead to improved service delivery and timely receiving of building materials. In order to enhance effective material procurement on construction sites, construction firms should lay more emphasis on training of procurement and management officers. Construction firms should engage more in the use of electronic material procurement. This will also enhance effective material procurement on construction sites to a great extent.

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