Factors Influencing Material Management Practices in Public Building Project Delivery in Southeast, Nigeria

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Abstract- ***Construction industry globally is faced with a lot of problems, among which is delay in project delivery and cost overrun which to some extent has been attributed to poor material management practices. This study sought to assess factors influencing material management practices in building project delivery in Southeast, Nigeria. The study population comprise of contractors, suppliers, consultants and clients in handling building projects in Southeast Nigeria with total population of 513. Multi-stage sampling technique was used to distribute 348 copies of questionnaire among the four strata. The study objective was achieved using confirmatory factors analysis and kruskal wallis test. The result from the confirmatory factors loadings showed three majorly factors loadings (grouping) from the nineteen items. Components one (On-site factors) has the highest number of loadings related to site induced factors, component two (external factors) with seven loadings related to external induced factors while the component three has three loadings related to stakeholders induced factors. Furthermore, result from kruskal wallis test on investigating the perception of major stakeholders on the subject matter revealed that contractor to a large extent determines efficiency and effectiveness of materials management practices in the study area hence upholding earlier findings that on-site factors is significant towards public building project delivery in the study area. The findings of this study have established that poor material planning and coordination, inefficient procurement system, stakeholders' communication gap, among others have grossly impaired material management practices. More so, the onus majorly lies on the site contractors to put in place measure to ensure effective material management practice in ensuring public building project delivery. While the site contractor is responsible for overseeing management of materials on site, however, the study recommended that project contractor should synergies with other project stakeholders to devise strategies for effective material management practices***

Indexed Terms- ***Material Management, Project Delivery, Stakeholders***

I. INTRODUCTION

Construction sector represents one of the most dynamic and complex industrial environments of the nations. This is due to the fact that construction industry globally is faced with a lot of problems, among which is delay in project delivery and cost overrun (Alade, Omonori, Lawal & Olowokere, 2019). To address this perennial challenge, Jefferson, Branco, Pereira and Silveira, (2018) opined that successful completion of projects requires all resources to be effectively managed as building construction materials constitute 60% to 70% of the total construction expenditure, depending on the type of construction project.

The core objectives of the construction industry which are to deliver project within a short time, reasonable cost, good quality and safety of occupants have stressed the need for effective resources management and control (Albert, 2014). Low and Ong (2014) evidenced that materials and human resources management are among the major factors that contributed to effective project delivery. More so, poor materials management results into project bottlenecks, limiting project success. The failure of project is attributed to poor materials management techniques that can result into poor quality materials, damage to materials, poor planning, late deliveries and high costs (Vipin & Rahima, 2019). Therefore, to prevent project failure proper materials management is vital. Ajayi *et al.,* (2017) also identified material management as an

integrated process of designing, constructing new structures or remodeling existing structures, using materials more efficiently with a great importance of contributing to construction performance improvement as well as solving material waste management problems.

Consequently, construction companies need efficient materials management measures to control productivity and cost in the construction projects (Ahmad, 2017). This is pertinent because materials management is a crucial function that improves construction projects' delivery (Ahmad, 2017). However, many problems impact the materials management functions, e.g., constraints on storage areas, site logistics regarding materials handling and distribution, late delivery of construction materials, unavailability of materials before commencement of construction work, and the long distance of materials from the work location, among others.

Recent literatures affirmed that materials account for about 60-70% of the building construction cost, hence effective management of construction materials is very important to building projects delivery (Patel & Vyas, 2011, Arijeloye & Akinradewo, 2016; Zairra, Kasim, Ibrahim & Sarpin, 2018). Despite the amount of money budgeted yearly for public building projects by federal and state governments, the public building projects suffered failure which has been attributed to improper handling of materials on site, poor planning and co-ordination, material changes in type and specification during construction, inadequate knowledge of materials management, unreliable supply from material suppliers, and inadequate waste management plan (Owolabi, Alfred & Olufemi, 2021). There are about 56,000 abandoned projects in Nigeria across the six geopolitical zones and the existence of this large quantum of uncompleted projects, estimating the cost at N12 trillion, most of these contracts failed due to poor cost estimation, poor materials planning and management, change in government and corruption as the most rated factors (Nigerian Institute of Quantity Surveyors (NIQS), 2021 & Nigerian Society of Engineers (NSE), 2021). Many projects were abandoned in Imo State, Southeast Nigeria as a result of poor materials management, poor project implementation and negative politics practiced by the government (Ikechukwu and Ozuzu, 2021). Wrong materials estimates, inflation, inadequate materials planning, poor risk management, inadequate finance and so on are the significant factors causing, abandonment of building projects in Uyo, Akwa-Ibom State and its metropolis (Nwanekezie and Nwanguma, 2019).

Ramachandran, Raj and Gandhi (2021) materials management practice are not perfectly known and practiced by the indigenous construction firms in developing countries which have resulted to failures in public building projects delivery, therefore there is need for further study on factors influencing effective materials management practices in the study area.

To address the issue of poor material management resulting into project failure, what then do construction professionals need to look out for in this dispensation? Hence this study.

II. MATERIALS AND METHODS

The study made use of survey research design approach which made use of validated questionnaire to elicit relevant information on the study's objectives. The study area of this research is Southeast Nigeria, which comprised five States: Abia, Anambra, Ebonyi, Enugu and Imo as shown in figure 3.1 and 3.2 respectively. The research covered only four states from the southeast (Imo, Abia, Ebonyi and Enugu), Anambra state was exempted due to significant political instability and unrest as at the time of carrying out this research work. The targeted population of the study comprised the contractor's, the subcontractors/suppliers, consultants and the clients of the selected ongoing public building projects in the study areas with a total population of 513 from a sample size of 348 from a total population of 513 using Yamane (1976) sample size formula. Thereafter, multi-stage sampling technique was adopted by first of all dividing the sample size among Contractor, Subcontractors/Suppliers, Consultants and Clients across the four states. Then, random sampling technique was used to select one hundred and seventy-one (171) contractor's, eighty-two (82) Subcontractor/Suppliers, sixty (60) Consultants and thirty-six (35) clients from 21 construction companies with ongoing public building projects. The data collected was analysed using SPPS version 25 by

carrying out confirmatory factor analysis (CFA) to assess the factors influencing material management practices. Also, Kruskal wallis was used to determine the perception of major construction stakeholders on the subject matter.

III. RESULT AND DISCUSSION

- Factor Analysis of Factors Influencing Materials Management Practices in Building Construction Projects Delivery

In the assessment of factors influencing materials management practices in building construction projects delivery, Kaiser-Mayer-Olkin (KMO) and Bartlett's test of sphericity value was used. Table 1 shows the result of KMO value reported as 0.933. This implies that KMO obtained 93.3% measure of Sampling adequacy suitable for this analysis. Moreover, the Bartlett's test of sphericity result value is 3291.637 at $p<0.05$ (0.000) confidence level, indicating statistically significant results. It can be deduced however, that the data obtained were suitable and adequate for Factor Analysis (FA) in the study.

- Communalities of Variables

The table 2 shows all the communalities of variables in the analysis. It is observed from the table that variable with the highest communalities value is market conditions accounted for 0.737% of variance after extraction in the analysis while the variable with the lowest communalities is ordering errors having 0.467% variance. The Principal Component Analysis (PCA) was used to determine the amount of variance in each variable which are explained by other variables.

For this study, three (3) factors were extracted as shown in Table 3. According to the table, the initial Eigen values of the three (3) extracted factors with variance explained before extraction for variables 1, 2 and 3 are 48.550%, 5.192% and 4.817% respectively accounted for 58. 560% total variance both before and after extraction.

The first principal component accounted for 22.620% of the total variance whilst the second component, explained 20.255% and Component 3 accounted for 15.685% of the variance. On this basis, component 1 was labeled as On-Site Related Factors, component 2 External Related Factors and component 3 was labelled as stakeholders Related Factors).

Component 1: On-Site Related Factors comprises Eight (8) variables, which accounted for 22.620% of the total variance; Poor planning & coordination (.811), Delay in materials procurement (.683), Labour skill and training (.667), Availability of materials (.658) Communication breakdown (.619), Insufficient equipment for handling (.573), Delay from manufacturers (0.544) and Supplier's Relations (0.503)

Component 2: External Factors accounted for 20.255 per cent of total variance. Seven variables loaded onto the component including: Market conditions, Price fluctuation, Project location and site conditions, Weather condition, Budget and fund constraint, Lack of waste management infrastructure, Cultural and local conditions with respective eigenvalues of 0.743, 0.662, 0.636, 0.604, 0.593, 0.591 and 0.515.

Component 3: Stakeholders Factors accounted for 14.109 per cent total variance not explained by the former two components: Change in Design and Scope (Variations) (0.768); Project Size and Complexity (0.685); Wrong Specification (0.624) and Environmental sustainability goal (0.611).

Going further on-site related factors are under the direct influence of the contractors. This implies that the onus rest majorly on the project contractors to ensures continuous availability and the optimum use of materials. This conforms with Jusoh and Kasim (2017) findings that eight specific groups out of 47 identified factors, management group has the highest number of influential factors which consists of 15 influential factors.

Factors on component 2 namely external factors are the factors outside the control of the project stakeholders which only the government can influence. Lastly, component 3 namely stake holders factors depend on the contractual terms between the clients and the contractors.

Table 1: KMO and Bartlett's Test of Sphericity

KMO and Bartlett's Test		
Kaiser- Meyer- Olkin Measure of Sampling Adequacy	.933	
Bartlett's Test of Sphericity	Approx. Chi-Square	3291.637
	Df	210
	Sig.	.000

Source: Authors Field Survey 2023

Table 2: Communalities for Correlation of Variables

Factors Affecting Materials Management Practices	Initial	Extraction
Market Conditions	1.000	.737
Budget and Fund Constraint	1.000	.646
Availability of Materials	1.000	.529
Project Size and Complexity	1.000	.501
Change in Design and Scope (Variation)	1.000	.661
Price Fluctuation	1.000	.626
Delay in Materials Procurement	1.000	.623
Environmental Sustainability Goal	1.000	.639
Wrong Specification	1.000	.511
Project location and site condition	1.000	.508
Delay from manufacturers	1.000	.662
Supplier's Relation	1.000	.515
Cultural and Local Conditions	1.000	.553
Poor Planning and Coordination	1.000	.563
Local Supplier Issue	1.000	.487
Inefficient Equipment for Handling	1.000	.582
Lack of Waste Management Infrastructure	1.000	.624
Weather Condition	1.000	.577
Communication Breakdown	1.000	.675
Labour Skill and Training	1.000	.614
Ordering Errors	1.000	.467

Source: Authors Field Survey 2023.

Table 3: Variance Explained by Determinants of Respondents

Total Variance Explained			
Component	Initial Eigenvalues	Extraction Sums of Squared Loading	Rotation Sums of Squared Loading

	Total	Initial % of Variance	Eigenvalues Cumulative %	Total	% of C=Variance	Cumulative %	Total	% of Variance	Cumulative %
1	10.196	48.55	48.550	10.196	48.550	48.55	4.750	22.620	22.620
2	1.090	5.192	53.742	1.090	5.192	53.742	4.254	20.255	42.875
3	1.012	4.817	58.560	1.012	4.817	58.560	3.294	15.685	58.560
4	.857	4.080	62.640						
5	.815	3.883	66.523						
6	.734	3.496	70.019						
7	.697	3.321	73.340						
8	.657	3.127	76.467						
9	.636	3.027	79.495						
10	.545	2.596	82.091						
11	.517	2.463	84.554						
12	.457	2.177	86.731						
13	.428	2.038	88.769						
14	.405	1.928	90.697						
15	.375	1.788	92.485						
16	.333	1.586	94.070						
17	.328	1.562	95.632						
18	.287	1.368	97.001						
19	.245	1.167	98.168						
20	.228	1.084	99.251						
21	.157	.749	100.000						

Extraction Method Principal Component Analysis
Source: Author's Computation 2023.

Table 4: Rotated Component Matrix using 0.5 as cut-off point

Factors Affecting Material Management	Component		
	1	2	3
On-Site Factors			
Poor planning and coordination	0.811		
Delay in materials procurement	0.683		
Labour skill and training	0.667		
Availability of materials	0.658		
Communication breakdown	0.619		
Insufficient equipment for handling	0.573		
Delay from manufacturers	0.544		

Supplier's Relations	0.503		
External Factors			
Market Conditions		0.743	
Price fluctuation		0.662	
Project location and site conditions		0.636	
Weather condition		0.604	
Budget and fund constraint		0.593	
Lack of waste management infrastructure		0.591	
Cultural and local conditions		0.515	
Stakeholders Factors			
Change in Design and Scope (Variations)			0.768
Project Size and Complexity			0.685
Wrong Specification			0.624
Environmental sustainability goal			0.611

Source: Author's Computation 2023.

Similarly, the study went further to investigate the factors influencing materials management practices based on the perception of the project major stakeholders namely the clients, contractors, consultants and the site engineers using Kruskal Wallis test. According to Pallant (2011), significant difference exists among groups when Asymp. Sig. in t-test-statistics table is less than 0.05 and vice versa. More so, to describe the direction of the difference (which group is greater), the median report table for the group needs to be considered. Result in table 5 shows there is statistically significant difference in factors influencing material management practices going by the perceptions of project stakeholders. Going further, to ascertain the most significant opinion among the stakeholders, the test statistics table was considered. Figures further reveal from median value that contractor have highest median values 87 compared to 41, 35 and 15 for consultant, client and site engineer respectively. Therefore, it was deduced that the contractor to a large extent determines efficiency and effectiveness of materials management practices in the study area. This result upholds the findings of Arijeloye and Akinradewo (2016) that to address ineffective materials management practices, contractors must be up and doing in ensuring proper work planning and scheduling and put in place measures to curb burglary, theft and vandalism of materials on construction sites.

Table 5: Kruskal Wallis Analysis of Influencing Factors Affecting Materials Management Practices based on Category of Respondents

Test Statistics[a,b]

	Factors of MMP
Chi-Square	17.612
Df	3
Asymp. Sig.	.001

a. Kruskal Wallis Test

b. Grouping Variable: categories of respondent

Frequencies					
		categories of respondent			
		contractor	Consultant	client	site engineer
Factors of MMP	> Median	75	42	0	50
	<= Median	87	41	35	15

CONCLUSION AND RECOMMENDATION

The findings of this study have established that materials management practice in the study area is influenced primarily by site related factors under the control of contractor. This was attributed to poor material planning and coordination and as well inefficient procurement system. The study also affirmed that external factors such as market conditions and project finance constraints have undermined effective material management practices in the study area. Hence, to ensure delivery of building project, contractors need to be proactive and devise strategies to ensure prompt delivery of materials to site. Also, effective communication system should be put in place to keep stakeholders abreast of latest information about variation in materials cost and proper material planning.

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