Evaluating Material Waste in Nigerian Construction Industry and Its Control Measures Amid Economic Recession

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ABSTRACT

Materials are products of raw items. Materials are made use of by many industries especially the construction industry which is a manufacture and trade based on building, maintenance and repairs of structures. Though materials waste is inevitable in the construction sub-sector, its control measures needs to be reviewed or obtained for maximum benefits especially during economic recession period of any nation. Construction industry is an important sector that contributes greatly in the economic growth of a nation, thus the need for this work. Questionnaires were structured to reflect the topic of discussion, responses were fathered and results analyzed with a view to consolidating on the premise of control measures. The economic sector is a large part of the economy. The target populations were grouped according to their place in the production chain, by their kind of work (product or service) or ownership. It involves the use of a designed questionnaire administered through convenience sampling techniques. Open-ended questions were employed to elicit the actual material waste control measures. Descriptive statistics tools are used to analyze the data. Findings revealed that major causes of material wastes in Nigeria construction industry are design changes/variation with mean value of 4.32 while workers mistake arising from low level of experience of 4.29 mean value; Inexperience of building professionals 3.71; Lack of proper supervision 4.14; etc. However, this study identified proper supervision, good storage facility, checking of material quality among others as mitigation measures to material waste control which are thus recommended to the construction practitioners in order to prevent economic recession.

Keywords: Construction Industry, Control Measures, Economic Growth, Economic Recession, Material Waste

INTRODUCTION

Construction sector represents one of the most dynamic and complex industrial developments in the world [1]. This affirms the view of [2], that the construction industry makes significant contributions to the social, environmental and economic development of society. According to [3], which was cited by [4], the construction industry in Nigeria is made up of an organized formal sector and an unorganized informal sector. The formal sector comprises foreign and indigenous companies, which are classified into small, medium and large sized firms according to their level of capitalization and annual turnover. The importance of the industry in the economy is relatively large; in most regions in the world about 10% of GDP direct contribution, and also a significant indirect contribution. The indirect contribution is caused by effects of construction in other sectors through a complex system of connection to these sectors, such as materials, chemicals, banking and other services. According to [5], the construction sector represents one of the most dynamic and complex industrial developments the world over. The construction activities in the context of the Nigeria economy cannot be treated with a wave of. [6] reported that the construction industry contributes about 3% to 6% of the gross domestic product [GDP] in developing

countries. A publication by NBSN [7] showed that GDP from Construction in Nigeria increased to 662431.53 NGN Million in the fourth quarter of 2018 from 544228.74 NGN Million in the third quarter of 2018, which shows the importance of constructionindustry to the growth of the GDP of the Nation.

The construction industry plays a strategic role in the Nigerian economy. According to Akindoyeni, A., (2004), in the industrialized countries, the construction industry can be responsible for up to 20% of the gross domestic product [GDP] and employs up to 12% of the total labor force. He stated that Nigeria is striving to reach this sub-optional state of development. The industry is responsible for 61% of the GDP and employs up to 20% of the labor force. All estimators allow wastage factor in pricing a bill of quantities. Over the years, experience has shown, however, that unless there is intensive management of site activities, wastage can frequently exceed, often by a large margin, than the figure allowed in the tender document. Control of material wastage seems like it has not been properly addressed because in the present situation, the management and the construction professionals are mainly concerned with how to control cost without any emphasis on waste control measures. The construction industry in particular and the production activity in general has been found to be among the main consumers of resources and energy. Moreover, the construction industry generates huge and unacceptable level of material and manpower waste which affect the economic growth of a nation and most often plunge the country into recession. These occurrences pose a lot of challenges and negative implications to the stakeholders and the image of the country. This Identification of the causes and application of relevant control measures is a step towards reducing its consequences. The aim of this study is to highlight major causes of material waste and control measures in a recessed economy.

There are diverse waste occurrences on site but the most common causes of waste in construction projects are physical raw materials. There are so many consequences because materials account for about 50% to 60% of construction cost, and they are scarce resources, [8], some of materials that get to sites end up as waste. Wastage of materials always occurs in construction projects and has several sources and causes [9]. Seven sources and 14 causes of material waste were revealed by [10] in Turkish construction projects while [11] identified 13 causes of material waste in Nigeria. The Sources as identified by [12] includes: Design, procurement, material, handling, operation, and residual.

Other causes highlighted by [13] are:
- lack of information or error about types and size of materials on design documents
- design changes and revision
- ordering of materials that do not fulfill project requirement
- damages of materials due to deficient storage and handling of materials
- imperfect planning of construction
- workers mistakes
- conversion waste from cutting uneconomical shapes
- lack of on-site material control
- lack of waste management plans

[14] Recommended the following as measures for controlling material waste:
- specification of standard sizes to minimize cutting wastes
- Material control should start at the design stage. Late design variation should be avoided while ensuring effective materials handling on site
- effective communication between suppliers and recipient
- accurate scheduling of materials to programmed delivery dates
- documentation should set out size, quality and delivery form of materials for estimators consideration
- procurement must specify quality, quantity, delivery time and method, and packaging
- preparation of effective planning programs
- effective procedure for issuing of materials on site
- training of both management and other staff
- Management must establish on site procedures for the reception of goods and plan for storage in advance.

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Materials of high value have to be hold   off-site until the last moment.

RESEARCH METHODOLOGY

In the study of [5] on construction waste management in Hong Kong public housing projects; there was the use of questionnaires that covered a wide range of topics concerning construction waste minimization; regular visits to know the scope of work done where wastes were generated by using a checklist of information and the quantities of waste estimated by visual inspections, tape (that is volume) measurements and truck load records.

In this study, primary data was obtained using structured questionnaires, interviews and site visits. Questionnaires were designed on structural basis to get information about personal data of the respondents to depict their profile and experience on issues relating to waste management in construction process.

A three – stage approach was used to conduct the study. The first stage involved review of literature on construction wastes, while the second and third stage involved observation and well-structured questionnaire administered through convenience sampling technique to professionals in selected practicing, contracting firm and academic institutions in South-East Nigeria. The causes of material waste as well as the control measures is measured on a 5-point scale where 5 represents 'Strongly Agree', 4 is 'Agree', 3 is 'Neutral', 2 is 'Disagree', 1 is 'Strongly Disagree'. Open ended question were asked to enable respondent add their own contribution which might not be stated in the questionnaire. The frequency and mean item score (MIS)of each group of response was calculated, dense ranking method was used to analyze the data.

The MIS is calculated as:

$$\frac{5n5+4n4+3n3+2n2+n1}{n5+n4+n3+n2+n1}$$

Where n5=very high, n4=high, n3=average, n2=low and n1=very low

RESERCH FINDINGS AND DISCUSSION

Respondents Profile

A total of 70 questionnaires were distributed and 56 copies were duly filled and returned representing 80% response rate. The respondents profile shows that 22 of them are Quantity surveyors while 8, 10, 12, 4 are Architects, Builders, service Engineers, safety officers respectively. These professionals were reached out to in order to get a holistic and concise response for the research analysis. Also 30 are Bachelor of Science (B.Sc.) degree holders while 21, 4, and 1 are Higher National diploma (HND), Master of Science (M.Sc.) and Ordinary National Diploma (OND) holders respectively.

Causes of Material Waste

Causes of material waste amid economic recession in the Nigerian construction industry were identified by the respondents as shown in Table 1. The table shows that all respondents agreed that all the causes generate material waste though their varying levels of agreement.

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Table 1: Causes of material waste

S/N	Causes	SA (5)	A (4)	N (3)	D (2)	SD (1)	Total	Mean	Rank
1	Design changes / variation	18	32	8	-	-	56	4.32	1
2	Workers mistake arising from low level of experience.	24	24	8	-	-	56	4.29	2
3	Ineffective communication	16	38	4	-	-	56	4.21	3
4	Loose delivery	16	38	2	-	-	56	4.21	3
5	Lack of proper supervision	10	44	2	-	-	56	4.14	4
6	Conversion waste from cutting uneconomical shapes	12	38	6	-	-	56	4.12	5
7	Poor site conditions	8	46	2	-	-	56	4.12	5
8	Misinterpretation of drawings	8	41	7	-	-	56	4.02	6
9	Unclear specification of materials	12	32	12	-	-	56	4.00	7
10	Estimators error	14	30	10	2	-	56	4.00	7
11	Material damage due to poor storage facility	8	36	12	-	-	56	3.93	8
12	Poor recording and documentation	4	46	2	4	-	56	3.89	9
13	Building defects and collapse	8	30	14	4	4	56	3.82	10
14	Mishandling of material	8	30	14	4	4	56	3.82	10
15	Ordering of materials not stated in the specification	10	34	6	2	4	56	3.75	11
16	Substandard material	8	30	8	6	4	56	3.75	11
17	Inexperience of building professionals	12	24	16	2	-	56	3.71	12
18	Loading and offloading of materials	10	28	12	4	2	56	3.71	12
19	Vandalism	8	32	10	2	4	56	3.68	13
20	Theft	6	30	14	4	2	56	3.61	14
21	Complexity of design	4	26	16	6	4	56	3.54	15
22	Poor working relationship	6	18	30	2	2	56	3.50	16
23	Poor site layout	4	26	16	6	4	56	3.36	17

Source: Study Findings (2019)

The table shows that design changes/ variation ranked 1st with mean of 4.32 which signifies the effect of variation on waste generation, Workers mistake arising from low level of experience, Ineffective communication, loose delivery, , ranked 2nd, 3rd, 3rd respectively. Lack of proper supervision is 4th with mean of 4.14, this is also a very important factor. Estimator's error ranked 10th, with mean of 8.00 which is also an important cause of material waste.

Since the Nigerian construction industry has a lot of quacks as reported by [3], many of these wasteful and unprofessional practices are common in the industry. This is perhaps the reason [7] [8] suggested avoidance of late changes to minimize wastage. [4] Opined that majority of the material waste during building construction emanate from rendering and blockwork mortar, and wood formwork.

[8] Argues that much waste occurs from decisions made by people with little direct involvement in site operations like the artisans, suppliers, laborers, etc. Therefore any good control measure should cut across them. This study shows that adequate efforts are not made to control material waste outside the site, especially at the design stage

Measures Adopted to Control Material Waste

The questionnaire contains open-ended questions which requests that the respondents should give more of their

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opinion on control measures not covered by the researcher to allow respondents add more control measures not listed. Table 2 shows the control measures which are 15 in number.

Table 2: Material Waste Control Measures

S/N	Control measures	Total number of respondent
1	Proper supervision	56
2	Effective communication	56
3	Inspection of material on arrival to site and adequate security of materials	56
4	Provision of good storage facility	56
5	Proper recording and documentation of material in and out flow	56
6	Daily stock taking	56
7	Use of material requisition booklet	50
8	Regular site meeting	46
9	Checking of material quality	56
10	Proper/careful handling of materials by workers	56
11	Sub-soil investigation before a project is embarked upon	38
12	Regular workshop training of site personnel and workers including store keepers	42
13	Reuse of materials	30
14	Proper error check by the estimator	56
15	Strictly adhering to design details	56

Source: Study Findings (2019)

The table above highlighted 15 material waste control measures. These control measures are meant to control material waste, they are also to be implemented at the various stages of work where they are required for it to be effective.

Estimators should always estimate in a good physical, mental and emotional state, to improve accuracy in estimates.

Before materials are approved for construction, they should be tasted and checked to ensure that they are of good standard and when they get to site, it should be inspected and stored in a good facility.

Benefits of Controlling Material Waste

The benefits of controlling material waste as detailed by the respondents include; increased efficiency of the project team, reduced final cost on project, increased contractors profit, reduced material shortage on site, reduced delay and increased timely delivery of construction projects. This was measured on a 5-point scale where 5 represents 'Very High', 4 is 'High', 3 is 'Average', 2 is 'Low', 1 is 'None'.Table 3 shows the benefits of controlling material waste.

Table 3: Benefit of Controlling Material Waste

S/N	Benefits	VH (5)	H (4)	A (3)	L (2)	N (1)	Total	Mean	Rank
1	Increase in contractors profit	18	32	4	2	-	56	4.18	1
2	Reduces material shortage on site	8	38	6	2	2	56	3.86	2
3	Reduce delay and enhances timely delivery of construction project	10	34	8	-	4	56	3.82	3
4	Reduce final cost on project	8	24	18	2	4	56	3.54	4
5	Increases accuracy of elemental cost of a project	10	22	14	8	2	56	5.54	4
6	Increases efficiency of project team	6	12	32	4	2	56	3.29	5

Source: Study Findings (2019)

Though 6 benefits were highlighted, there are so many other benefits of controlling material waste which should motivate professionals in the construction industry to aim at controlling waste (waste management.)

CONCLUSION

This study reveals 23 causes of material waste amid economic recession in the construction industry, 15 control measures, and 6 benefits of controlling material waste. It also shows that adequate efforts are not being made by construction practitioners to control waste of material throughout all the stages of construction. Government needs to contribute more towards aiding the construction industry in the development and growth of the economy effectively. Effective site management is lacking in the industry while quacks and inexperience are notable key players in the industry.

RECOMMENDATIONS

In the view of the findings, the study recommends;

1. Construction practitioners make adequate efforts to ensure material waste control through all the stages of construction by applying the control measures listed in this research. They are also to take cognizance of the 23 causes highlighted in this paper in order to guard against them in their projects.
2. Government should ensure the involvement of relevant experienced professionals in the industry.
3. A clause in the conditions of contract should state the latest time allowed for a client to make changes to any part of the project to reduce wastage of materials arising from variation
4. The use of ICT in Technological tools which can show real life videos of working progress to increase proper supervision even when the site Engineer or supervisor is not on site
5. Recycling of material should be encouraged. This should be checked properly to avoid using degradable materials, materials from demolitions and construction waste on landfilling in the name of recycling to avoid building collapse which will result in more material waste.
6. That professionals should not indulge in favoritism to improve on the working relationship.

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