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### Impact of Construction Material Wastage on Project Cost and Project Delivery in Nigerian Construction Industry

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#### Abstract

Materials management in construction projects is an important function that significantly contributes to the success of a project. Poor management of materials on site during construction process would influence the total project cost, time and quality. The study examined the causes and impact of construction material wastage on project cost and project delivery in Nigerian construction industry. The specific objectives were to: Ascertain the causes of construction material wastage in project delivery in Nigerian construction industry and determine the impact of construction material wastage on project cost in Nigerian construction industry. Research design was descriptive survey research. Study Area was Enugu State. Sample size of 378 respondents was drawn from 503 population of the study using Taro Yamane sample technique. The research

question was answered with simple percentage, mean and standard deviation while methods of data presentation are table and simple percentage. The hypotheses were tested with ANOVA and single regression analysis. The following are the major findings of the study: The study revealed that there is significant cause of construction material wastage in project delivery in Nigerian construction industry ( $t$  – statistics (6.716) > its P-values (0.000) and construction material wastage has significant impact on project cost in Nigerian construction industry (-8.446) > its P-values (0.000). The study recommended that Nigerian construction industry should improve in the standard of the contract documents to avoid wastage resulting from poor documents, design changes, and changes of the client's requirements and avoiding design errors should be done.

**Keywords:** Construction Material Wastage, Project Cost, Project Delivery

#### Background of the Study

The construction industry plays a vital role in meeting the needs of society and enhancing quality of life. The construction industry contributes to the socio-economic growth of any nation by improving the quality of life and providing the infrastructure, such as roads, hospitals, schools, and other basic facilities. Hence, it is imperative that construction projects are completed within the scheduled period of time, within the budgeted cost, and meet the anticipated quality. However, being a complex industry, it is faced with the severe problems of cost overruns, time overruns, and construction waste (Elikem, Anglamgne & Ahuma-Smith, 2018) <sup>[3]</sup>.

Materials management in construction projects is an important function that significantly contributes to the success of a project. Poor management of materials on site during construction process will influence the total project cost, time and quality (Whyte, Isaac & Lilly, 2018) <sup>[10]</sup>. Material wastage is one of the major causes of contractor's business failure in developing countries (Andualem & Aklilu, 2019) <sup>[2]</sup>. The reduction in construction materials wastage can significantly help in increasing total profit and gaining economic stability for a country and construction firms. Project managers and construction staff usually fail to control materials in construction projects and unable to identify the root causes of materials wastage due to absence of appropriate tools to measure it (Ibrahim & Winston, 2019) <sup>[8]</sup>. Construction materials wastage is considerable where poor management is a norm (Ghanim, 2022) <sup>[7]</sup>. Construction site staff and project manager can reduce the construction waste with efficient management (Adewuyi & Otali, 2019) <sup>[1]</sup>. The reduction in construction waste can significantly help in increasing total profit and gaining economic stability for a country and construction firms. Wastage of construction materials is much greater than the minor figures assumed by the companies while estimating cost of the project (Elikem, Anglamgne & Ahuma-Smith, 2018) <sup>[3]</sup>. So, materials management is a vital function for improving productivity in construction projects. The

management of materials should consider at all the phases of the construction process and throughout the construction and production periods.

There are many ways through which causes of wastage can be identified in construction. Waste can be categorized according to its source (Garba & Shiferaw, 2021) <sup>[5]</sup>. Waste may result from process preceding construction, such as material manufacturing, design, material supply, and planning as well as the construction stage. Wastage in construction sites is often due to inadequate storage and protection, poor or multiple handling, poor site control, over ordering of material, bad stock control, lack of training, and damage to material during delivery (Ibrahim & Winston, 2019) <sup>[8]</sup>. Most researchers categorized these causes into four categories (Adewuyi & Otali, (2019) <sup>[1]</sup>, procurement, handling, operation, and culture; while another researcher (Andualem & Aklilu, 2019) <sup>[2]</sup> grouped factors generating material wastage into design, procurement, handling of material, and operation.

### Statement of the Problem

Wastage on construction site has become a canker worm in Nigerian construction industry. This problem has negatively affected the performance of many projects in Nigeria (Adewuyi & Otali, 2019) <sup>[1]</sup>. Wastage is seen in many ways as peculiarity of construction projects. This means that many construction works have wastage because it is an issue that cannot be divorced from construction work.

In Nigeria, around the construction project site; there are many wasted of construction materials. This shows that construction materials wastage management has not received attention from researchers and project managers. However, construction materials are costs are increasing from day to day in addition to this waste is becoming a serious problem since it is a high-cost component and effects on the environment, especially on projects delivery in Nigerian construction industry public building construction has not received enough attention.

Then, this research determines the current situation with regard to cause of construction material waste in Nigeria especially in Enugu North. Therefore, it is against this background that this study sought to establish the causes and impact of construction material wastage on project cost and project delivery in Nigerian construction industry.

### Objectives of the Study

The broad objective of this study is to examine the causes and impact of construction material wastage on project cost and project delivery in Nigerian construction industry. The specific objectives were to:

1. Ascertain the causes of construction material wastage in project delivery in Nigerian construction industry.
2. Determine the impact of construction material wastage on project cost in Nigerian construction industry.

### Significance of the Study

The outcome of this study is beneficial and relevant to government, policy makers and researchers.

The outcome of this study would be beneficial to Nigeria government by providing recommendations that gears towards performance improvement in project. The study would reveal to government that a solid monitoring system would provide the basic data necessary to conduct evaluations in order control material wastage.

The outcome of the study would point-out to policy makers the important of providing monitoring and evaluation report to project donors who provide technical assistance through financing the programs; the reports level of transparency and accountability which goes a long way in determining the credibility of the program and influencing future funding.

Finally, the outcome of this study would equally be useful to scholars and researchers, it would serve as reference materials that are reserve in libraries and shelves for further academic research. The study empirical findings are capable of adding new insights to present knowledge in the field.

### Conceptual Framework

#### Construction Waste

Construction waste is a global challenge facing both construction practitioners and researchers. It can have a significant impact on time, cost, quality and sustainability, as well as on the success of projects. It is the difference between purchase and actual use (Ghaleb, *et al*, 2021) <sup>[6]</sup>. Garba and Shiferaw, (2021) <sup>[5]</sup> contend that waste is any surplus or unwanted material persistently causing environmental issues and global warming. Consequently, waste has been described as any constituent generated, as a result of construction work, and abandoned, irrespective of whether it has been processed, or stocked up before being abandoned (Adewuyi & Otali, 2019) <sup>[1]</sup>. Therefore, Adewuyi and Otali, (2019) <sup>[1]</sup> concludes that waste is anti-sustainability that paves the way towards sustainability. Many scholars view construction waste as any human activity that consumes resources, but creates no value, such as mistakes that require rectification, waiting time/waste of time, cost, unwanted production/overproduction, management of work programmes, and poor constructions (Adewuyi & Otali, 2019) <sup>[1]</sup>.

#### Causes and impact of construction material wastage on project cost in Nigerian construction industry

Construction waste results during the lifecycle of buildings; starting from design, going through construction, modifications and ending with demolition (Garba & Shiferaw, 2021) <sup>[5]</sup>. A number of studies concluded that the design phase is one of the primary causes of construction waste. Ghaleb, *et al* (2021) <sup>[6]</sup> stated that poor design models and decisions are among the main factors that make the design phase responsible for early waste in construction materials. According to Elikem, Anglamgne and Ahuma-Smith, (2018) <sup>[3]</sup> causes of construction material wastage can be divided into two categories: *Non-site based* and *site-based*. Non-site-based wastage largely occurs due to over-ordering of materials (Adewuyi & Otali, 2019) <sup>[1]</sup>, design errors (Ghanim, 2022) <sup>[7]</sup> and design changes (Ibrahim & Winston, 2019) <sup>[8]</sup>. According to Eze, Seghosime, Eyong and Loya, (2017) <sup>[4]</sup>, good specifications, clear design and effective procurement strategy can reduce wastage. Site-based wastage is the actual loss of materials during site operations. According to Lu *et al.* (2011), careful transportation, handling, storage and coordination can reduce site-based material wastage. Site-based material wastage can be further divided into two categories: Upstream and downstream (Elikem, Anglamgne & Ahuma-Smith, 2018) <sup>[3]</sup>. Upstream wastage is generated prior to the construction phase. It is mainly caused by improper material handling and storage (Bossink and Brouwers, 1996). Al-Ani and Al-Adhmawi (2011) showed the importance of the

monthly material wastage report in order to compare it with the allowable waste to maintain the quality management system. Downstream wastage is generated at the construction phase. It is mainly caused by material cutting (Faniran and Caban, 1998). Cosgun and Esin (2007) found that the main causes of downstream wastage are unskilled workers, inadequate tools and poor working conditions.

### **Theoretical Framework**

#### **Zero Waste or waste minimization Theory**

Zero waste, or waste minimization was propounded by Paul Connett in 1970. The zero-waste approach seeks to maximize recycling, minimize waste, reduce consumption and ensures that products are made to be reused, repaired or recycled back into nature or the marketplace. Zero waste, or waste minimization, is a set of principles focused on waste prevention that encourages redesigning resource life cycles so that all products are repurposed (i.e. "up-cycled") and/or reused. The goal of the movement is to avoid sending trash to landfills, incinerators, oceans, or any other part of the environment. Currently 9% of global plastic is recycled. In a zero-waste system, all materials are reused until the optimum level of consumption is reached. Zero waste refers to waste prevention as opposed to end-of-pipe waste management. Zero waste encompasses more than eliminating waste through reducing, reusing, and recycling. It focuses on restructuring distribution and production systems to reduce waste. Zero waste provides guidelines for continually working towards eliminating waste.

According to the Zero Waste International Alliance (ZWIA), Zero Waster is the conservation of all resources by means of responsible production, consumption, reuse and, recovery of all products, packaging, and materials, without burning them and without discharges to land, water, or air that threaten the environment or human health. Advocates expect that government regulation is needed to influence industrial choices over product and packaging design, manufacturing processes, and material selection. Advocates say eliminating waste decreases pollution and can also reduce costs due to the reduced need for raw materials.

### **Empirical Review**

#### **Causes of construction material wastage in project delivery in Nigerian construction industry**

Saidu and Shakantu, (2023) <sup>[9]</sup> examined the effects of material-waste and their control measures on project-cost overruns at the site-management stage of a project. The study covers building-construction professionals in Abuja, Nigeria, from which a purposive sample of 30 professionals was drawn. Interviews were conducted with the sampled professionals; and in the process, quantitative data were generated by using a tick-box questionnaire. The data were analysed by using the descriptive and inferential methods. The research analysis indicated that material waste and its control measures have significant effects (very high, high, medium, low, and very low) in causing, or minimising, cost overruns on construction projects at the site-management stage of a project. There were no significant differences in the views of the professionals on these issues. The study recommended that site managers of both private and public buildings should achieve the best value for money to the client; a reduction in the amount of waste that would be sent to landfills; and a reduction in the number of cost overruns

on projects with appropriate material waste control.

Ghanim, (2022) <sup>[7]</sup> examined the causes and magnitude of wastage of construction materials on construction projects sites in Jordan. To achieve the research aim, the researcher had prepared a questionnaire form included questions about the causes of wastage and the estimated percentages of wastage of ten most popular kinds of materials used on construction sites in Jordan. The number of causes adopted was 60 distributed on the six major categories. The form was distributed to 240 participants (clients, contractors, and consultants). The study revealed that the most important causes of wastage of materials on construction sites in Jordan are frequent design and client's changes; rework due to workers mistakes; poor contract documents; wrong and lack of storage of materials; poor strategy for waste minimization; shortage and lack of experience of skilled workers; poor site conditions; damage during transportation; theft and vandalism; and mistakes in quantity surveying and over allowance. In addition the study concluded that the percentage of wastage materials is accounted for by values between 15% and 21% on Jordanian construction sites.

Garba and Shiferaw, (2021) <sup>[5]</sup> investigated cause of construction material wastage and rank highly wasted construction material wastage on public building projects in western Oromia. The Study uses both primary and secondary data by structured questionnaires and case study (interviews and site visits). The research has covered a population of General and Building contractors from level one to three and their supervisor's that are employed in western Oromia on public buildings. The purposive sampling techniques were used to collect the data and Analyzed and presented by mean score. The result of the study analyses, mostly causes of construction materials are; changes made to the design while construction is in progress, lack of attention paid to dimensional coordination of products, damage during transportation, improper planning for required quantities, designer's inexperience in method and sequence of construction. The study recommends that shareholders are responsible on wastage management because wastage is not the only profit of contractors it also affects the environment and consumes the resource of the country inefficiently, so all stakeholders must headily participate for wastage management and control.

Ghaleb, Ahmad, Mujahed, Mohammed, Waleed, Abu-Khader and Rateb, (2021) <sup>[6]</sup> conducted a study to explored the causes of material wastage in the Construction Industry. Specifically, the study sought to identify the major causes of material waste in construction projects, determine the level of wastage for some selected materials and suggest strategies to manage and minimize wastage. In order to facilitate the application of this research, Jordan was taken as a case study. The results from 61 returned surveys suggested 49 factors which were then analyzed to identify the main causes of material wastage; the main factors are as follows: Design changes during the construction phase, rework due to labor mistakes, purchases not complying with specifications, improper cutting of materials and poor site layout. The study concluded that the most important advantages of managing and minimizing material wastage are minimizing time and cost overruns and helping in determining the required quantities, thus leading to improved project performance.

### Impact of construction material wastage on project cost in Nigerian construction industry.

Andualem and Aklilu, (2019) <sup>[2]</sup> investigated the causes of materials wastage in building construction projects in Ethiopia. Specifically, the study sought to collect data from building construction projects from the respective respondents from Bahir Dar city in Ethiopia. Questionnaires were distributed to the main stakeholders who were involved in the building projects to identify the frequent causes of wastage of materials from the factors that were extracted from literature review. The data analyzed using the Relative Importance Index (RII) technique to quantitatively measure the occurrence of the variables. The study revealed that workers mistake, loss of onsite material control and selection of low-quality products were the major causes of construction materials wastage in building construction projects in Bahir Dar. The study recommends that contractor should control workers to avoid wastage occurs due to mistakes during construction. Qualified personnel should be assigned to control onsite materials.

Adewuyi and Oтали, (2019) <sup>[1]</sup> evaluates the causes of construction waste generation on building sites in Rivers State, Nigeria. The statistical techniques used to analyse the data collected are Mean score method, ranking method and Man-Whitney U test. The results of analysis showed that the three most important factors contributing to construction material waste generation on building sites in Rivers State, Nigeria are “rework contrary to drawing and specification”, “design changes and revision” and “waste from uneconomical shapes” respectively. It was also discovered that inappropriate equipment contributed least to waste generation on site and there is little “bottle neck” in obtaining work permit by contractors in Rivers State, Nigeria. The study revealed that all the 74 factors were considered important by the respondents. The study showed that there is no significant difference between the consultants and contractors perception about the factors affecting construction waste generation on building sites in Rivers State, Nigeria. This study therefore recommended that construction stakeholders should consider the studied factors at every level of the construction processes and in their waste management plan.

Elikem, Anglamgne and Ahuma-Smith, (2018) <sup>[3]</sup> investigated implication of waste generation on construction project delivery in the Upper West Region of Ghana. The specific objective of the study was to finding out how much construction waste is costing construction project delivery and attempted to make suggestions to the industry on how waste can be minimized in order to maximize profits. The study employed both qualitative and quantitative method of sampling which allowed appropriate and accurate data organization, analysis and interpretation. The research revealed that a number of construction companies in the study area do not adhere to international best practices and standards of waste management on construction sites, such as waste minimization strategies. Maintenance of human resources was also found to be non-existent in these construction firms. There is the need for effective supervision and enforcement of by-laws regulating waste management on construction sites.

### Gaps in Literature

Elikem, Anglamgne and Ahuma-Smith, (2018) <sup>[3]</sup> investigated implication of waste generation on construction

project delivery in the Upper West Region of Ghana, the study was domiciled in Nigeria. Ghanim, (2022) <sup>[7]</sup> examined the causes and magnitude of wastage of construction materials on construction projects sites in Jordan and failed to discuss causes and impact of construction material wastage on project cost and project delivery in Nigeria. This study wants to bridge the knowledge gap and embedded in causes and impact of construction material wastage on project cost and project delivery in Nigerian construction industry.

### Methodology

The research design was descriptive survey method. Study Area was Enugu State Nigeria. The sample size of 399 respondents were drawn from population of 503 staff of selected four local construction firms in Nigeria using random sampling method. They are Marlum Nigeria Ltd, Fitech Construction Ltd, Achimore Nig Ltd and Boritz Nig Ltd The choice for only staff of the organization was owing to the nature of this study and due to accessibility and availability of data. The study used structured questionnaire to obtain data. Research questions of the study were answered using mean score and standard deviation. The hypotheses stated were tested using one-way ANOVA and single regression method. Methods of data presentation was table. Statistical Package for Social Science (SPSS) is computer Application Software was used for the data analysis.

### Data Presentation and Analysis

**Table 1:** Comprehensive Demographic of Respondents

Title	Frequency	Percentage
<b>Questionnaire Distribution</b>		
Questionnaires Distributed	399	100%
Returned Questionnaires	240	61%
Not Returned Questionnaires	159	39%
<b>Gender</b>		
Female	146	61%
Male	94	39%
<b>Age Bracket</b>		
21-30 Years	130	54%
31-40 Years	80	33%
41-50 Years	25	10%
51 Years – above	5	3%
<b>Marital Status</b>		
Married	145	60%
Single	83	35%
Widow/widower	7	3%
Divorce	5	2%

Sources: Field Survey, 2023

Three hundred and ninety-nine (399) copies of questionnaires were designed and distributed to the respondents. Out of the 399 Questionnaires distributed, 240 (61%) were completed and returned while 159 (39%) were not returned. Therefore, 61 percent respondents were a good representation. The study showed the respondents profile in frequency and percentage distribution of gender, age bracket and marital status.

### Data Analysis

**Question One:** What is the causes of construction material wastage in project delivery in Nigerian construction industry?

**Table 2:** Mean rating of responses from respondents on what the causes of construction material wastage in project delivery in Nigerian construction industry?

S. No	Questionnaire Item	VGE(5)	GE(4)	M(3)	LE(2)	VLE(1)	Total	Mean	SD
1	Poor material specifications and lack of clear design increase construction wastage.	870	148	42	20	5	1085	4.520	0.102
		174	37	14	10	5	240		
		62%	21%	8%	6%	3%	100%		
2	Poor transportation system and careless delivery increases site-based material wastage.	770	228	36	22	6	1062	4.425	0.088
		154	57	12	11	6	240		
		50%	33%	7%	6%	5%	100%		
3	Unskilled workers, inadequate tools and poor working conditions increases site-based material wastage.	790	204	66	14	2	1076	4.483	0.098
		158	51	22	7	2	240		
		53%	29%	13%	4%	1%	100%		
4	Poor construction storage programe and coordination increase site-based material wastage.	825	136	60	24	9	1054	4.392	0.093
		165	34	20	12	9	240		
		57%	19%	11%	7%	5%	100%		
Grand Mean								4.455	0.0955

This table showed the opinion of respondents on what is the causes of construction material wastage in project delivery in Nigerian construction industry. The respondents are in agreement with all the items. The study thereby revealed that there is significant cause of construction material wastage in project delivery in Nigerian construction industry

since poor material specifications and lack of clear design increase construction wastage (grand mean (4.455) is greater than cut-off mean (3.00).

**Question Two:** What is the impact of construction material wastage on project cost in Nigerian construction industry?

**Table 3:** Mean rating of responses of respondents on what is impact of construction material wastage on project cost in Nigerian construction industry

S. No	Questionnaire Item	VHE(5)	HE(4)	M(3)	LE(2)	VLE(1)	Total	Mean	SD
1	Material wastage creates no value on project cost and failed to meet the anticipated quality	835	188	42	14	5	1084	4.517	0.101
		167	47	14	7	5	240		
		5%	27%	8%	4%	3%	100%		
2	Material wastage reduces total profit and cause economic instability in construction firms.	860	228	21	6	1	1116	4.650	0.115
		172	57	7	3	1	240		
		61%	33%	4%	2%	1%	100%		
3	Material wastage waste construction time and result to unwanted project	790	204	66	14	2	1076	4.483	0.098
		158	51	22	7	2	240		
		53%	29%	13%	4%	1%	100%		
4.	Material wastage results project overrun within the budgeted cost	830	132	60	24	9	1055	4.396	0.089
		166	33	20	12	9	240		
		58%	19%	11%	7%	5%	100%		
Grand Mean								4.512	0.300

This table showed the opinion of respondents on what is the impact of construction material wastage on project cost in Nigerian construction industry. The respondents are in agreement with all the items. The study thereby revealed that construction material wastage has significant impact on project cost in Nigerian construction industry since material wastage reduces total profit and cause economic instability in construction firms (grand mean (4.512) is greater than

cut-off mean (3.00).

**Test of Hypotheses  
Hypothesis One**

H<sub>1</sub> = There is no significant causes of construction material wastage in project delivery in Nigerian construction industry.

One-Sample Statistics				
	N	Mean	Std. Deviation	Std. Error Mean
There is no significant causes of construction material wastage in project delivery in Nigerian construction industry.	240	4.5385	2.43637	.67573

One-Sample Test						
	t	Df	Sig. (2-tailed)	Mean Difference	Test Value = 0	
					95% Confidence Interval of the Difference	
					Lower	Upper
There is no significant causes of construction material wastage in project delivery in Nigerian construction industry.	6.716	12	.000	4.53846	3.0662	6.0107

The result of the one-way ANOVA analysis showed the model to ascertain the causes of construction material wastage in project delivery in Nigerian construction industry. The results of the t – statistics denoted that there is

significant causes of construction material wastage in project delivery in Nigerian construction industry because observed values of t – statistics (6.716) was greater than its P-values (0.000). However, we rejected the null hypothesis

and concluded that there is significant causes of construction material wastage in project delivery in Nigerian construction industry.

**Test of Hypothesis Two**

H<sub>2</sub> = Construction material wastage has no significant impact on project cost in Nigerian construction industry.

Model Summary				
Model	R	R Square	Adjusted R Square	Std. Error of the Estimate
1	.931 <sup>a</sup>	.866	.865	.26055

a. Predictors: (Constant), Construction material wastage

ANOVA <sup>a</sup>						
Model	Sum of Squares	Df	Mean Square	F	Sig.	
1	Regression	58.809	1	58.809	11.604	.000 <sup>b</sup>
	Residual	1211.252	239	5.068		
	Total	1270.061	240			

a. Dependent Variable: Project cost  
b. Predictors: (Constant), Construction material wastage

Coefficients <sup>a</sup>						
Model		Unstandardized Coefficients		Standardized Coefficients	t	Sig.
		B	Std. Error	Beta		
1	(Constant)	.454	.089		5.111	.000
	Construction material wastage	.422	.050	.931	8.446	.000

a. Dependent Variable: Project cost

In testing this hypothesis, construction material wastage was regressed against project cost. The result of the single-regression analysis showed the model to determine the impact of construction material wastage on project cost in Nigerian construction industry.

$$\text{Project cost} = 0.454 - 0.422 \text{ construction material wastage}$$

The empirical result showed that the coefficient of construction material wastage has negative effect on project cost; it means that construction material wastage has negative and indirect influence on project cost. The results of the t – statistics denoted that the coefficient of construction material wastage was statistically significance. This is because observed values of t – statistics (-8.446) was greater than its P-values (0.000). The results of the F – statistical test showed that the overall regression of the hypothesis two was statistically significance. This was because observed value of the F – statistics (11.604) was great than its P-value (0.000). Again, our empirical result showed that the Pearson product moment correlation analysis (r) was 0.931. The strength of relationship between the two variables was high. However, we rejected the null hypothesis and concluded that cconstruction material wastage has negative and significant impact on project cost in Nigerian construction industry.

**Discussion of the Findings**

**Causes of construction material wastage in project delivery in Nigerian construction industry**

The study revealed that there is significant cause of construction material wastage in project delivery in Nigerian

construction industry since poor material specifications and lack of clear design increase construction wastage (t – statistics (6.716) >its P-values (0.000). The outcome of the study was in line with the study of Saidu and Shakantu, (2023) that examined the effects of material-waste and their control measures on project-cost overruns at the site-management stage of a project. The data were analysed by using the descriptive and inferential methods. The research analysis indicated that material waste and its control measures have significant effects (very high, high, medium, low, and very low) in causing, or minimising, cost overruns on construction projects at the site-management stage of a project. There were no significant differences in the views of the professionals on these issues.

**Impact of construction material wastage on project cost in Nigerian construction industry**

The study revealed that construction material wastage has significant impact on project cost in Nigerian construction industry since material wastage reduces total profit and cause economic instability in construction firms (-8.446) > its P-values (0.000). The outcome of the study was in line with the study of Adewuyi and Otali, (2019) [1] that evaluated the causes of construction waste generation on building sites in Rivers State, Nigeria. The statistical techniques used to analyse the data collected are Mean score method, ranking method and Man-Whitney U test. It was also discovered that inappropriate equipment contributed least to waste generation on site and there is little “bottle neck” in obtaining work permit by contractors in Rivers State, Nigeria. The study revealed that all the 74 factors were considered important by the respondents. The study showed that there is no significant difference between the consultants and contractors perception about the factors affecting construction waste generation on building sites in Rivers State, Nigeria.

**Summary of Findings**

The following are the major findings of the study:

1. The study revealed that there is significant cause of construction material wastage in project delivery in Nigerian construction industry since poor material specifications and lack of clear design increase construction wastage (t – statistics (6.716) >its P-values (0.000).
2. The study revealed that construction material wastage has significant impact on project cost in Nigerian construction industry since material wastage reduces total profit and cause economic instability in construction firms (-8.446) > its P-values (0.000).

**Conclusion**

The study concluded that there is significant cause of construction material wastage in project delivery in Nigerian construction industry and construction material wastage has significant impact on project cost in Nigerian construction industry. The cause of construction material wastage in project delivery in Nigerian construction industry includes changes made to the design while construction is in progress, lack of attention paid to dimensional coordination of products, damage during transportation, improper planning for required quantities, designer’s inexperience in method and sequence of construction are causes wastage in all attribute groups in high degrees. It shows that lack of

management interest and noninvolvement of key stakeholders in decision-making and design factors leads to cause wastage of construction. Construction material wastage creates no value on project cost and failed to meet the anticipated quality, material wastage reduces total profit and cause economic instability in construction firms, material wastage waste construction time and result to unwanted project and material wastage results project overrun within the budgeted cost. General construction shareholders are responsible on wastage management because wastage is not the only profit of contractors it also affects the environment and consumes the resource of the country inefficiently, so all stakeholders must headily participate for wastage management and control.

### Recommendations

Based on the findings of this study, the following recommendations were made.

1. Nigerian construction industry should improve in the standard of waste avoidance resulting from design changes, changes of the client's requirements and construction design errors. Preparing better storage facilities near the site, employing qualified on-site administrative staff by the contractors to avoid mistakes in quantity surveying and over allowances, avoiding material procurement mistakes and poor inventory management are recommended.
2. Construction site managers should adopt site meeting during monitoring and evaluation to help them discover material wastage in construction site bottlenecks earlier to avoid cost overrun. There is need to include all site visitation in project monitoring and evaluation in each stage.

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