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Sources and Causes of Material Waste and Effect of Material Waste on Cost Overrun in the Construction Industry: A Case Study

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ABSTRACT:*This research work studies the sources and causes of Material Waste and effect on Cost Overrun at preconstruction and construction phases of abuilding projecton some selected Construction companies in Nigeria. The Relative Importance Index (RII) method was employed to analyse the primary data gotten from the responses to the structured questionnaires sent to the respective selected construction companies. From the findings, last minute client requirement was ranked highest as the factor that leads to design variation with relative importance index value of 3.97; cost of construction materials was ranked highest as a factor that affects selection of construction materials with relative importance index value of 4.05.*
KEYWORDS: *Material waste,Cost Overrun, Preconstruction and Construction Phases, Relative Important Index.*

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I. INTRODUCTION

It is no news that the company that specialize in construction perform a vital function within the economic boom and growth of a countries. Economic affairs are greatly relying on the existence of a solid construction companies for the provision of jobs, investment prospects, and development of infrastructure in every sector of the economy. According to Osmani et al. (2008), industries that specialize in construction activities are among the active forces that causes the growth of any country socially and economically. Due to high rising standard of living and urbanization, there is this common characteristic for the growing demand for construction projects, especially in developing nations, and the supplementary prerequisite to provide accommodation for their countries (Nagapan et al., 2012).

The formation of facilities involves a huge monetary disbursement which makes the concentration of industries that specializes in construction more on machinery, personnel and materials (Babatunde, 2012). Industries that specialize in construction adds to environmental dilapidation through the creation of waste (Tam, 2008; Dania et al. 2007). They mentioned the various problems which are associated with the waste and they included, land use deterioration, waste resource depletion, air pollution, and non - availability of land. They also stated that all these problems are related to health and the environment, which in turn affects the optimal financial productivity of most projects in Nigeria. Adewuyi&Otali, (2013); Ameh&Itodo, (2013); Imam et al., (2008); Oladiran, (2009) "all agreed that both in developing and developed countries, cost overrun is a shared problem". Thus cost overrun has made it hard to finish several ongoing projects within the stipulated budget, quality and time.

Memon et al. (2013), reported that most developing nations experience overrun exceeding 100% of the initial budget of the project. Again Apolot et al. (2010), and Allahim& Liu (2012), "noted in their studies that most times there are disagreement between built-environment professionals, project users and project owners for the past seven decades in industries that specialize in construction on measures to completely remove or reduce the overrun in the budget of projects". Lessons from other countries have revealed that material waste generated from construction industries characterizes a huge amount on the costs of construction. Consequently, the mismanagement of construction materials and waste tends to add to the overall project cost (Ameh&Itodo, 2013). Likewise, Teo et al. (2009) "states that construction materials wasted on-site adds to cost overruns, which lead to non-completion of projects within the calculated and estimated cost".

Sequel to the information above, Nagapan et al. (2012) declared that industries that specialize in construction has to develop its alertness, because material wastages can cause a negative effect on the construction sustainability, quality, cost and time of construction projects.

1.1 Statement of the problem

Nguyen et al., (2002) states that in spite of the studies that have stressed the future profits of reducing construction waste, there has been little growth in applying the waste-management opportunities available, to ensure that construction waste is properly reduced.

There is a problem of poor understanding and lack of awareness among the Nigerian construction professionals of the causes and sources of material waste generation at the different phase of a project.

1.2 The Aim of This Research Work

This research work aims at investigating theSources and Causes of Material Waste and Effect of Material

Waste on Cost Overrun in some selected Construction Companies in Nigeria.

1.3 Objectives of This Work

The objectives of this research work in regards to the aim are as follows:

i. To detect the causes and sources of construction material-waste at preconstruction and construction phase of a project

ii. To establish the effects of material-waste on cost overrun.

1.4 The Construction Industry in Nigeria

In the first decade after independence in Nigeria, modern construction which was referred to as the temp was at a low ebb. Only urban areas had the modern constructions which were considered the seat of the government as it marked the change or transition in the nation's growth. Hence, economic activities were on a low ebb owing to the 1967-1970 civil war. Wahab and Alake (2007) in their work stated that from 1971 and 1975, the company observed activities triggered by rehabilitation and re construction of programs incidental from the massive destruction in the course of the civil war. Property investment was largely trending, by 1974, the year's growth in the industry was 269.40%.

"In Nigeria in the late 60's and early 70's the oil boom witnessed the emergence of indigenous and foreign companies into the industry" (Ogunbiyi 1998). Conversely, there was a little drop in the industry development which got more obvious as years passed from 1976 to 1980. The Nigerian construction industry emerged from Public Works Department (PWD), it transited into the federal ministry of works. The three tiers of government, the local, state and federal award 70% of the construction contracts project while the remaining 30% is left in the hands of private section. "The construction company project plays a very important role in the economy of Nigeria". Akindoyeni (2004) "states that in technologically advanced countries, 20% of the Gross Domestic Product (GDP) is accounted for by the construction industry and which account for 12% of the labor force". "He concluded that Nigeria is yet to reach the state of gladness over the issue, the company is still in charge of 61 percent of the Gross Domestic Product (GDP) and hires up to 20 percent of the work force". The pattern of process is seen as the most prevalent required in Nigeria.

Indigenous contractors are described as such owned and controlled by Nigerians according to (Idoro 2007). He described expatriate as multinational contractor's workers and private firm normally jointly owned by both a Nigerian and expatriates but mainly headed by expatriates.

Oladapo (2007) states that the construction company in Nigeria is of two types, viz;: Organized formal sector and Unorganized information types. The organized formal sector consists of both foreign and indigenous industries, these are further grouped into large, medium and small firms in accordance with their levels of capitalism and yearly income.

1.5Types of Construction Waste at Preconstruction and Construction Phase

Figure 1.0 Organisation Structure of Waste, Nagapanet al. (2012).

1.5.1 The preconstruction phase of a project

This phase includes events ranging from the feasibility phase to the phase of award. These comprise the practicability, scheme design, outlined proposal, bills of quantities, estimation, detail design, etc.
If these phase are not well controlled, it could result in waste-generation and overruns the cost of the project (Ashworth, 2008). Therefore, it is good to also recognize the causes of construction waste that will give rise to overrun of the construction at this phase.

1.5.2 The Construction Phase of a project

This phase start from building on site to final handover to client and worker profession, improvement of deficiencies and conclusion of construction supplies and balance of the closing financial records (Ashworth, 2008). Nevertheless, this part of study would place emphasis on building connected matters. It can be deduced from the study that identifying causes and its correlation of waste provides clear advantage to the environment and the construction company in economic aspect.

II. LITERATURE ASSESSMENT

Ahmed et al. (2016), studied on cost overrun and delay in construction of public projects, Qatari. Data for the study was gotten from Qatari public work authority, ASHGHAL starting from public roads, building and drainage. The researcher adopted Analysis of Variance (ANOVA) and regression method of analysis as methodological tools. The study indicates that cost overrun for projects increase along with decreased contract prices, while the cost overrun for drainage projects reduces with improved contract price.

Ibrahim et al. (2013) "work on factors influencing cost overrun in building projects, West Bank, Palestine". The goal is to discover risk map and factors influencing construction in projects. This was based on sample given by 26 construction experts in Palestine. Statistical analyses tool was adopted by the researcher for severity and frequency.40 factors were identified from the study, one was found in the green zone, this is the low zone, and this zone can have risk which could be ignored. 14 factors were also found on the yellow zone, this is the moderate risk zone, and risk within this zone can be adequately controlled. 26 factors found on the red zone should be given adequate attention as it is a very vital zone, its risk should be given maximum attention. Consequently, "researchers suggest that in order to regulate cost overrun in the course of construction projects, material price and labor amount should be recent, payment should be made early". Ample period should be set aside for making feasibility studies, tender submissions, designs, data documentation and planning. Coordination and communication of projects participants should be more during all level of project. Timely training and workshops should be carried out to increase management abilities of project participants and top management must have a positive reaction towards environmental and political changes by the help of management strategies as well as financial policies.

Saidu et al. (2017) "carried out a study research on the link between material waste causes and that of cost overrun at all phases of a project". "Finding revealed that study of material waste regarding the preconstruction level is 96.88% while at construction level is 81.36% of the causes of cost overrun at the preconstruction and construction phases of a project respectively". The researcher contacted 30 constructions professionals during the study, the technique adopted by the researcher is purposive sampling technique functioning as a methodological tool. It's been noted that for a good construction material waste to be achieved, management must be at its peak for projects, causes of material waste must be controlled from the very beginning and the root causes at the different levels of the project. The researcher suggested that project cost overrun can be effectively minimized and managed by obstructing or preventing the causes of material waste.

Sasitharan at al. (2012) conducted a study on identifying various factors that affect construction waste, Malaysia. Data was gotten for the study by using a well sound and structured questionnaire which entails three (3) principal groups involved in the everyday management of the project, the contractors, the client and the consultants. (SPSS) Statistical software and spearman correlation analysis was adopted by the researcher as a methodological tool. It was observed that data gotten from the study was efficient and there are five (5) principal causes of construction waste: Lack of experience, poor time management, inadequate supervision and site management, errors on both construction and design. "Results from the spearman Rank correlation analysis indicate that there is measured information between parties with a correlation value of 0.60 and errors during projects are highly correlated with Rework correlation value of 0.829 and vice versa". It can be deduced and concluded from the study that tracing the causes of construction waste and its correlation gives a lucid understanding and is of importance to the economy as well as construction companies.

III. MATERIALS AND METHODS

3.1 Data Collection

Primary data was collected through a structured questionnaire and semi structured interviews programmed to produce particular reactions for excellence and arithmetical analysis. The respondents chosen

for this study are as follows; managers, quantity surveyors, Senior technical officers (Waste management) and other site personnel such as architects, builders, site engineers and foremen. This group of the respondents was selected because they have good understanding on financial and environment risk posed by material waste during construction process.

3.2 Data Analysis

This research was restricted to only companies that are involved in construction activities in Port Harcourt as regards to issues of sources and causes of material waste and effect of material waste on cost overrun on site.

Rivers state was chosen because vast majority of construction activities were currently on going. Also, "about 60% of potential clients that patronize construction company in the country are from Rivers State" (Ajanlekoko 2001). Sample frame for this research was acquired from construction/Building firms manual (2003). 20 construction firms based in Rivers state were chosen for the sample frame. This research has adopted several approaches to evaluate sources, causes and effect of material waste on cost overrun from construction process. Also, Bossink and Brouwers (1996) employed transforming method, while Serpell and Labra (2003) employed the method of interview. Questionnaire that touched various topics relating to sources, causes and effect of materials waste on cost overrun were adopted, several visit to where material wastes were gotten in order to know the extent of work carried out with the help of a checklist of information and by measuring tape, visual inspections and records of truckloads the volume of waste were estimated. Primary data in this research was gotten through visits to site and response gotten from the structured questionnaires interviews. Questionnaires were out in place on structural grounds to access the demographic information of the respondents and experience to deport their profile on matters bordering on sources, causes and effect of material waste on cost overrun in the construction company in Rivers State. The surveys were planned following the technique implemented by Poon et al. (2004). Also to look at the sources, causes and factors leading to material waste on the sites involving construction activities. 80 well-structured questionnaires were given to professionals who had deep awareness of waste produced through building works. The efficiency of the survey is dependent upon measurement scale so as to get the causes of waste generation and a sum of 75 were retrieved and found helpful which accounts in return rate of 93.75%. Also personal interviews were carried out with a view to complementing the questionnaires administered to the respondents.

Engineers, Architects, Builders and Foremen were the participants in the interview by treating matters relative to material waste control approaches, site activities. Visiting of sites was done to find the meters applied at the site handling construction activities to cope streams of generated waste. The information gotten were analyzed by employing inferential and descriptive statistical tools. In indicating the level of the factors contributing to construction waste, The Relative Important Index (RII) method was employed. Also from the analysis of the ranking shown by the respondents with the use of five- point like scale, the RII for each factor was computed. The value of 1,2,3,4 and 5 were respectively not important, fairly important, important, more important and very important. The RII is the correlation among the summation of the weight value (SWV) and the sum total of respondents' rankings. The closer RII to 5 indicate the higher in importance of the factors categorized above. The SWV is the sum of the product of the value added to each rating and exact number of respondents. -that is:

$SWV=\Sigma\, x_i\, y_i$ (3.1)

Then (3.2)

where;

x_i indicates number of response to rating i,

$y_i$indicates the value of rating i (i = 1 to 5).

Also, the arithmetic mean was used as a statistical tool

The arithmetic mean $(\bar{x}) = \dfrac{\sum fx}{n}$ (3.3)

where

n = number of individual values

$\sum fx$ = sum of individual values

3.3 Validity of the data

For the purpose of this study, all the information brought forward are factual supported by the nature to physical pre-interviews, opinion of the respondents expressed preliminary test amongst a purposive sampling of companies not added in the survey

IV. RESULTS AND DISCUSSIONS

4.1 Results

This section analyzes the primary data collected through structured questionnaires and semi structured interviews planned to draw precise responses for quantitative and qualitative analysis respectively. The main units of measure used to present the results were percentages, mean, frequency distributions, and Relative Important Index (RII).

4.1.1 Result of Sources of Construction Wastes Generation

Table 4.1 displays that 19 of the workers that respondedspecified that over consumption of incomes accounts for (0 to 20%) causes of waste, however about 28 of the workers that responded specified that (21 to 40%) causes waste. Around 34 of the workers that responded indicated that composite and deep design of building accounts for (0 to 20%), whereas around 13 of theworkers that responded specified that it was by (21 to 40%). Also around 15 of the workers that responded specified that waste causes on site due to weather and in appropriate storage which accounts for (0 to 20%), around 26 of the workers that responded specified (21 to 40%) of causes and around 7 of the workers that responded reported (41 to 60%) of causes. Around 10 of theworkers that responded specified that mishandling or careless delivery accounts for (0 to 20%) of the causes; around 12 of theworkers that responded reported (21 to 40%), while about 28 of the workers that responded indicated (41 to 60%). Around 9 of the workers that responded specified that vandalism accounts for (0 to 20%) of the causes; around 29 of the workers that responded specified that (21 to 40%) of the causes, and around 9 of the workers that responded reported (41 to 60%). Around 13 of the workers that responded reported rework/improve works accounts for (0 to 20%) of the causes, about 9 of the workers that respondedspecified it was by (21 to 40%), and around 28 of the workers that responded reported (41 to 60%) causes.

Around 9 of the workers that respondedspecified poor recording of materials supplied accounts for (0 to 20%) of the causes, around 22 of the workers that responded reported (21 to 40%), and about 19 of the workers that respondedspecified that it was 41 to 60%. About 6 of the workers that responded reported (0 to 20%) of the causes; about 31 of the workers that responded reported (21 to 40%) causes, and about 10 of the workers that responded specified that it was 41 to 60%. See Tables 4.2 to 4.4

4.1.2 Result of Factors That Causes Wastes On Construction Sites

i. Design variation

Table 4.2 The highest factor affecting wastages on construction sites that falls between the level of important and more important were reported as last minute client requirement with relative important index (RII) of 3.97. The other factors that follows are reported as complex design with (RII) value of 3.87 and lack of design information with (RII) value 3.56 and the two were between more important and important levels of wastages. However unforeseen ground condition, lack of communication and long project duration have (RII) values of 2.32, 2.10 and 2.04 respectively and the three falls between important and fairly important levels of construction waste.

ii. Construction Material Selection

Table 4.3 indicated that cost has the highest (RII) value (4.05) that falls among very important and moderately important levels of waste production. Simplicity of construction, Client requirement, and availability of material have (RII) values of 3.79, 3.70 and 3.45 separately that are among more important and important levels of waste production. Whereas construction site space, equipment availability and proficiency have (RII) values of 2.91, 2.47 and 2.13 respectively and falls among important and fairly important and production of construction waste has (RII) value of 1.93 that falls between not important level of construction waste production.

4.1.3 Factors Affecting Waste On Construction Site

I. Construction Method

Table 4.4 Displays that construction cost has the highest relative important index value of 3.86 that falls between more important and important levels of waste production.

construction time and developer's requirement have relative importance index (RII) value of 3.67 and 3.30 respectively that falls among more important and important levels of waste production. While familiarity with the construction technology and dependence of labour have relative important index (RII) values of 2.28 and 2.23 separately and falls among important and fairly important levels of waste production. Reduction of waste has relative important index (RII) value of (1.87) that falls among fairly important and not important levels of waste production on project construction-sites.

4.1.4 Waste Control Measure Method

Table 4.5 indicated that 9.10% of the workers that responded specified that they used prefabricated elements although 90.90% of the workers that responded specified that they did not use it.

Table 4.6 showed that 14.29% of the workers that responded specified that they carried out sorting on generated waste while 85.71% of the workers that responded specified that they do not carry out exercise of sorting.

Table 4.7 shows that 70.5% of the workers that responded specified that they practiced dumping-openly, 16% practised burning-openly and 13.5% practised composting of disposal. This study conducted discovered that due to overcrowded and narrow site space in most construction area in the study region, limited space in site is the utmost projecting factor disturbing the ways of sorting on-site. Therefore, visitation to site and personal-interviews conducted indicates that most construction sites failed to carry out sorting of waste generated during the process of construction and there was unintended removal of waste from site. Table 4.8 specifies that 100% of the workers that responded specified that they had not calculated waste-indices on their generated waste which could serve as a guide to identify the volume of waste per-surface-area.

4.2 Discussion of Results

From the received data it was discovered that 78.60% of the workers that responded indicated that they were in medium sized firm, 10.00%of the workers that responded indicated that they were in large-sized company and 11.40%of the workers that responded indicated that they were in small- sized company.

In the structure of ownership of the companies the workers that responded showed that 89.86% were in indigenous companies and10.14%of the workers that responded specified that they work in overseas companies. The length of experience of 50.66% of the works in companies declared they have 0 to 5years, about 16.21% of the companies had 6 to 10 years, around 9.33% of the companies had11 to 15 years and around 8% of the companies had 16 to 20 years. Data about the respondent's profile revealed that they had been in the business for years now, which have provided the opportunity for them to have good understanding about problems regarding construction waste on sites. construction waste-sources are characterised into material procurement; design; operation; left over related, material handling and others. The finding from the study revealed that about 59.60%of the workers that responded specified that about 21 to 40% of waste were caused by excess consumption of resources, about 72.34% of the workers that responded specified that about 0 to 29%of waste were caused by composite and deep design of building. Around 52% of the workers that responded specified that about 21 to 40% of waste were caused by material damage due to weather and unsuitable storage, roughly 56% of the workers that responded specified that around 41 to 60% of waste is caused by material damage on site due to mishandling or careless delivery.

Approximately 61to 70% of the workers that responded specified vandalism accounted by 21 to 40% as waste-cause. Approximately56% of the workers that responded revealed that improve/rework accounted by 41 to 60% as waste-cause, about 44 of the workers that responded showed that deficiency of recording materials supplied on-site and used on-site accounted by 21 to 40% as waste-cause and around 65.90% of the workers that responded specified that site office waste accounted by 21 to 40% as waste-cause on building site. Poon et al. (2003) "identified the factors that affect the selection of construction materials as cost, client's requirement, material available, efficiency of construction method (time/quality) ease of construction, available equipment, site space and production of waste". The result of this study discovered that the issues that affects the selection of construction-materials that were related to wastes are arranged in order of importance as follows: (Cost; ease of construction; client requirement; materials availability; site space; availability of equipment; efficiency; production of waste) which follows the ranking order from 1 to 8 respectively.

Poon et al. (2003) "also identified the factors that cause design variations as last minute requirement, complex designs, lack of communication between designer, contractors and engineers, lack of design information, unforeseen ground condition and long project duration". Finding of this study discovered that the factors that led to design-variations that are incidental to wastes are arranged in order of their prominence from 1 to 6. (Last minute client requirement; complex design; lack of design information; unforeseen ground condition; lack of communication; and long project duration). Poon et al. (2003) "also identified the factors that determine the selection of construction method as construction time, construction cost, and familiarity with the construction technology, developer's requirement, labour dependence and waste reduction". Finding in this work revealed that the factors that led to selection of construction-method that are also incidental to wastes are also arranged in order of importance, that is from the highest to the least. (construction cost; construction time; developers' requirement; familiarity with the construction technology; labour dependence; and waste reduction). 90.90% of majority of the respondents' showed that they do not apply the use of prefabricated elements in their construction works while only 9.10% of the respondent's applied it in their construction works. This exercise imposed the method of wet trade which is an on-site construction process, which plays a key production to waste generation on construction sites. From the study it was revealed that more time is spent on construction work when wet-trade method is employed which in turn led to creation of more wastes than the use of dry-trade

construction method. The findings gotten from the analysis of this work revealed that majority (85.72%) of the workers that responded indicated that their companies do not sort out waste generated on-site, whereas 14.28% of them indicated that sorting out exercise were carried out. This method has encouraged random dumping of refuse sent to landfill without seeing the environmental consequences of the waste on the health and safety of the community. Also the commercial significance of the waste-materials was not taking into consideration by the respondents' on how sorted-out waste materials can be re-used for building work or sold out to be recycled into raw materials. The waste index calculation objective is to aid the project manager of a construction project to estimate the quantities of waste that will be created in order to establish awareness on management to develop a good planning on resources and environmental management, and to reduce waste generation at all phases of the construction project.

Findings from the study revealed that the respondents do not ensured calculation on waste index. This situation has made it difficult for the project administrators to determine in advance the magnitude of material waste that can be generated in a project per (m^2). Mcdonald and Smithers (1998) "indicated that Waste Management Plan list is required to be produced by contractors while bidding for projects to show how wastes generated would be handled". The findings also show that most of the respondents' revealed that their companies do not integrate Waste Controlling Plan (WCP) in submitting their application or contract documents to the concern authority.

Also, WCP was not made compulsory or important document to be submitted during tendering. Therefore, the minds of the contractors were not prepared on the ways and manner to deal with generated waste in a more viable manner on site.

Table 4.1 Sources of construction-waste generation.

S/N	Sources of construction waste.	0 to 20% Freq (%)	21 to 40% Freq (%)	41 to 60% Freq (%)	61 to 80% Freq(%)	81 to 100% Freq (%)
1.	Over consumption of resources.	19 (40.40)	28 (59.60)	------	------	------
2.	Composite and the design of building	34 (72.34)	13 (27.66)	------	------	------
3.	Materials damage due to weather and inappropriate storage	15 (31.25)	26 (54.17)	7 (14.58)	------	------
4.	Material damage on site due to mishandling or careless delivery	10 (20.00)	12 (24.00)	28 (56.00)	------	------
5.	Vandalism	9 (19.15)	29 (61.70)	9 (19.15)	------	------
6.	Rework/Improve	13 (26.00)	9 (18.00)	28 (56.00)	------	------
7.	Lack of recording					
8.	Materials supplied on site and used on site	9 (18.00)	22 (44.00)	19 (38.00)	------	------
9.	Site office waste	6 (12.77)	31 (65.96)	10 (21.27)	------	------

Source: Researcher's Survey, 2018

Table 4.2 Relative importance index of causes of design variation.

S/N	Factors	VI (5)	MI (4)	I (3)	FI (2)	NI (1)	SWV =Σxiyi	RII	Ranking
1.	Last minute client requirement	32	22	14	7	2	306	3.97	1
2.	Complex design	22	33	14	6	2	298	3.87	2
3.	Lack of design information	14	22	36	3	2	274	3.56	3
4.	Unforeseen ground condition	3	11	13	31	19	179	2.32	4
5.	Lack of communication	3	4	9	43	18	162	2.10	5
6.	Long project duration	6	8	7	18	38	157	2.04	6

Source: Researcher's Survey, 2018

Table 4.3 Relative importance index (RII) of causes of construction materials selection.

S/N	Factors	VI (5)	MI (4)	I (3)	FI (2)	NI (1)	SWV = Σxiyi	RII	Ranking
1	Cost	33	22	16	2	3	312	4.05	1
2	Simplicity of construction	14	20	29	11	3	292	3.79	2
3	Client requirement	20	23	10	12	3	285	3.70	3
4	Availability of materials	10	33	19	12	3	266	3.45	4
5	construction site space	6	14	33	15	9	224	2.91	5
6	Equipment availability	6	7	20	28	16	190	2.477	6
7	Proficiency	7	6	7	27	30	164	2.13	7
8	Production of waste	6	7	2	23	39	149	1.93	8

Source: Researcher's Survey, 2018

Table 4.4 Relative importance index (RII) of factors affecting selection construction method.

S/N	Factors	VI (5)	MI (4)	I (3)	FI (2)	NI (1)	SWV = Σxiyi	RII	Ranking
1	construction cost	27	25	15	7	3	297	3.86	1
2	construction time	22	33	14	6	2	283	3.67	2
3	Developer's requirement	8	23	33	10	3	254	3.30	3
4	Familiarity with the construction technology	4	4	22	27	20	176	2.28	4
5	Labour dependence	4	4	10	47	12	172	2.23	5
6	Reduction of waste	4	4	8	23	38	144	1.87	6

Source: Researcher's Survey, 2018

Table 4.5 Pre-fabricated elements usage

Response	Frequency	Percentage
Yes	4	9.10
No	40	90.90
Total	44	100.0

Source: Researcher's Survey, 2018

Table 4.6 Streams Construction Waste Sorting-out

Response	Frequency	Percentage
Yes	2	14.29
No	12	85.71
Total	14	100.00

Source: Researcher's Survey, 2018

Table 4.7 Method of generated waste disposal.

Method	Frequency	Percentage
Open dumping	31	70.50
Open burning	7	6.00
Compositing	6	13.50
Total	44	100.00

Source: Researcher's Survey, 2018

Table 4.8 Calculations of Waste Indices.

Response	Frequency	Percentage
Yes	0	0.00
No	50	100.00
Total	50	100.00

Source: Researcher's Survey, 2018

V. CONCLUSION AND RECOMMENDATION

5.1 Conclusion

Cost-overrun and material waste are recognized as a worldwide issue, this often impedes the progress of many construction projects. Moreover, many construction project managers are indifferent specifically to the outcome of waste gotten on cost overrun. This publication was geared towards the sources, causes and effect of material waste on cost overrun in all phases of a constructionproject. The purpose of this study was to investigate the sources, causes and effect material waste on cost overrun in some selected companies in Nigeria. Objectively, to achieve this aim, the sources, causes and effect of material waste on cost overrun was investigated and the sources of material waste and cost overrun was identified (Table 4.1)

Also it was illustrated that last- minute client requirement was ranked highest as an agent owing to variation of design (Table 4.2). Cost of construction of a project was ranked highest as the leading factor affecting selection of construction-method (Table 4.4) and the purchasing power of construction materials used was also ranked highest, as a collective cause of waste owing to how construction-materials was chosen (Table 4.3). All these were the identified causes of material-waste and cost-overrun at all phases of construction project. Management emphasized on materials that are mainly affecting cost of project. This work revealed that most respondents opted for the use of Wet trade construction process instead of the use of prefabricated elements, this has given rise to numerous amount of waste and cost overrun. The survey indicated that waste index was not calculated because project managers of the respondents' firms were oblivious of its significance. The knowledge of calculating waste-index could definitely have been useful in helping the construction professional have an earlier data of waste created, and to cultivate decent planning of capitals and method of control for subsequent waste that could be gotten by similar projects previously handled as a reference point

5.2 Recommendations

Centered on the finding and outcome of the entire work, the recommendations below were made to boost efficient material-waste handling practice for project construction in Rivers State.

1. The personnel of construction projects should guarantee that efficient handling of material from design phase to construction phase is done well enough to minimize methods that often lead to wastes generation in construction.
2. construction companies should ensure that proper facilities are made available for construction-materials to be effectively warehoused with pallets at the base to prevent damages which can result to waste generation.
3. Whenever wet trades are used; it is always very important to adequately carry out sorting exercise on site.
4. To reduce to its barest minimum the amount of generated waste, prefabricated elements should be used amongst contracting firms.
5. A policy should be enforced which will be binding on contracting firms mandating calculation of waste-indices to control the volume of waste generated so that appropriate procedures will be put in place to regulate waste generation.
6. Project designers should understand the differences among the materials stated in the course of design and those procured for in the course of site work in order to direct the site workers on how to avoid waste in material waste when executing construction projects.
7. A policy binding contracting firms to adopt waste management plan (WMP) is needed. This will be incorporated into one of the documents expected during tendering process from contracting firms.
8. An orientation ought to be given to workers on site to educate them on the ecological and health effects correlated with waste gotten from materials used in the course of construction process.

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