

Empirical study of effectiveness of construction waste minimization in Bauchi state

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Abstract

This paper critically investigates and analysed the to determine the level of waste minimization practices in Bauchi State, Nigeria. In practice, there has been a tremendous increase in building construction which led to the generation of waste at different stages of construction. The structure of Nigerian construction industry is complex having different types of clients and contractors. This consist of public and private clients, main contractors and sub-contractors, indigenou and foreign companies, low technology firms and sophisticated specialists, builders and civil engineers and a whole range of construction professionals connected within the industry. The growing popularity of Public Private Partnership (PPPs) also means more international construction firms are likely to come into the Nigerian construction industry. The materials and methods was that questionnaire design was undertaken to determine the opinion of contractors on waste minimization practices in the study area. The sample group identified comprises project managers, project engineers, quantity surveyors, site supervisors and the method of distribution and collection of the questionnaire survey is through google by Survey Monkey. The questionnaire was constructed using Likert scale. The respondents were asked to rank on a scale of 1-5 waste minimization strategies on construction sites. The population of this research were construction firms in Bauchi participating on different types of construction projects. In this research, use of census is administered. A total number of 77 construction firms with valid registration in Nigeria. The result of the survey on the level of waste minimization practices in Bauchi construction industry. Reuse on site with the highest mean of 3.86 is in the high category and ranked first. The reuse on site is the most frequent practice on construction site. The second ranked mean is 3.57 also in the High category which represent the proportion of respondents that minimize waste at the source of origin. The finding of the research study shows that the study emphasized the Reuse is the most acceptable way of waste minimization in construction site in the study area. From the findings of this research study, its recommended that the contraction firms should have waste management plan regardless of its size as this will reduce both physical and non-physical waste and increase the profit.

Keywords: waste minimization, construction site, reuse, reduce, recycle, construction industry.

Introduction

Construction work is often described by either type, residential (home building) or non-residential (commercial and government buildings and infrastructure projects), or by funding source, public or private (Alwi *et al.*, 2002). The construction sector represents, for many countries, a core economic activity (Adetunji, Price, & Fleming, 2008). It not only provides the infrastructure for all other industries, but also constitutes one of the largest single sectors in the economy on its own (Ayodele, Ogunjuyigbe, & Alao, 2017). For the developing economies, the construction sector plays a significant role because of its link to the development of basic infrastructure, training of local personnel, transfer of technologies, and improved access to information channels (Haufler, 2013). In practice, there has been a tremendous increase in building construction which led to the generation of waste at different tages of construction (Wahab & Lawal, 2011;

Madawaki, 2012). Previous research also revealed that the construction industry, while contributing to overall socio-economic development of any country is a major exploiter of natural non-renewable resources and a polluter to the environment where by it contributes to the environmental degradation through resources depletion, energy consumption, air pollution and generation of waste in the acquisition of raw materials (Al-Hajj & Hamani, 2011).

The structure of Nigerian construction industry is complex having different types of clients and contractors. This consist of public and private clients, main contractors and sub-contractors, indigenou and foreign companies, low technology firms and sophisticated specialists, builders and civil engineers and a whole range of construction professionals connected within the industry (Oluwakiyesi, 2011; Fadiya, Georgakis, Chinyio, & Nwagboso, 2012). The major divisions in the industry are building construction division and civil or heavy engineering construction division. The Nigerian construction industry continues to be the major stimulant in the country’s economic growth and development (Koch & Leidner, 2013). This strong interrelationship between the economy and the construction industry further strengthens the need to ensure that project planning and management are cost-effective (Babatunde & Low. 2013). These were due to design errors, unexpected site conditions, increasing project scope, weather conditions and other project changes. It is also evident that those contractors who perform and deliver their earlier projects successfully fails to deliver similar projects in future and facing time and cost overrun (Odeyinka & Yusif, 1997; Somorin, Adesola, & Kolawole, 2017). In view of this, the iron triangle (on time, under budget, according to specifications) which has been widely accepted criteria for project successful and economic delivery during the last couple of years in the Nigerian construction industry can no longer be the sole determinant of project successful and economic delivery criteria due to changes in demands of users, evolving environmental regulations, shifting functions of projects, the inherent risks and the inhibiting risk factors associated with construction projects (Adeagbo & S.U, 2005; Ayodele et al., 2017).

Nigeria as a nation is still at the infancy stage of infrastructural development where a lot of construction activities are being carried out across the nation by the federal, state and local governments as the major clients in Nigeria (Oyedepo, 2014). All these construction activities are carried out by construction companies either indigenou or multinationals whose structure at times affects the level of construction output in the construction industry. But, the execution of most of these construction works are being carried out by the foreign construction firms but changes in government, transformation agenda and local content policy in infrastructural sector has created rooms for Nigerian indigenou contracting firms to grow and participate in the developmental processes (Odediran, et al, 2012). There is more than five hundred ongoing construction works in Bauchi state.

The growing popularity of Public Private Partnership (PPPs) also means more international construction firms are likely to come into the Nigerian construction industry as observed by (Odediran, *et al.*, 2012).The medium-size construction companies in Nigeria includes; Costain W.A. Plc, PW Nigeria, Cappa & D’Alberto, Stabilini Visinoni, Bi-Courtney Limited, Lekki Concession Company, Reynolds Construction Company Ltd and Setraco Nigeria Limited. There are also many low-size construction companies that execute large proportion of construction works in the Nigerian construction industry (Mudi, Bioku, & Kolawole, 2015). Like other nations of the world, In Nigeria according Etuk *et al.*, (2014) and Somorin et al., (2017) construction companies could be classified as small, medium and large. As presented in table 1.

Table 1: Different sizes of construction firms in Nigeria
(Etuk *et al.*, 2014)

Size	Number of Employees	Total cost including working capital but excluding land
Small	11-35	1Million – less than 40Million
Medium	36-100	40Million – less than 200Million
Large	101 and above	200Million and Above

In Nigeria, results of researches obtained showed that there are no adequate human and material resources for formulation and implementation of waste management policies, (Igbinomwanhia, 2014). There is urgent need for the formulation and implementation effective and efficient solid waste management policies in

Bauchi state and Nigeria in general. World-wide, researches contributed tremendously in the field of construction waste minimization but only few writings are made in Nigeria. Table 2. shows some of the previous studies on construction waste minimization in Nigeria.

Table Error! No text of specified style in document.: Previous studies on construction waste minimization in Nigeria

Author (s)	Title	Gap
Shankari, <i>et al.</i> , (2017)	Causes and minimization techniques of materials waste in Nigerian construction process.	This research focused on Causes of materials waste, Control techniques and Contribution of material waste minimization. the research is limited to 14 control techniques
Akinkulore & Franklin, (2005)	Investigation into waste management on construction sites in south western Nigeria.	The author concerned with Method of keeping store records and Sources of waste on building sites, with 8 and 11 variables respectively
Dania, et al., (2004)	A study of construction material waste management practices by construction firms in Nigeria.	Focused on the causes of waste on construction sites and factors which may affect the effectiveness of solid waste management.
Adekunle & Olufemi, (2014)	Resources conservation and waste management practices in construction industry.	The researcher focused on causes and waste handling method but not include source reduction.
Odusami & Ibrahim, (2012)	Evaluation of materials wastage and control in some selected building site in Nigeria.	Concerned with the factors that contribute to material waste and strategies for minimizing material wastage.
Adeyuyi and Otali, (2013)	Evaluation of causes of construction material waste case of rivers state in Nigeria.	Focused on the causes of construction material waste.
Ola-adisa, <i>et al.</i> , (2015)	An Architectural Approach to Solid Waste Management on Selected Building Construction Sites in Bauchi Metropolis	Examined the problems of waste management on construction site
Idris, et al., (2015)	An Evaluation of Material Waste and Supply Practice on Construction Site in Nigeria	Identified the major source of material supply, storage and wastages in building construction site

Materials and Methods

The questionnaire design was undertaken to determine the opinion of contractors on waste minimization practices in Bauchi. The questionnaire consists of three parts of closed-ended questions. The use of questionnaire survey enable the researcher to investigate the waste minimization strategies in the case study area. The sample group identified comprises project managers, project engineers, quantity surveyors, site supervisors and the method of distribution and collection of the questionnaire survey is through google by Survey Monkey. The questionnaire survey consists 3 parts which address the materials waste minimization practices on construction project. The questionnaire was constructed using Likert scale. The respondents were asked to rank on a scale of 1-5 waste minimization strategies on construction sites. The population of this research were construction firms in Bauchi participating on different types of construction projects. In this research, use of census is administered. A total number of 77 construction firms with valid registration in Corporate Affairs Commission were identified and selected as target population.

Result and Discussion

This is the analysis of data for the objective of the research study, which is, to determine the level of waste minimization practices in Bauchi State, Nigeria. The result of the survey on the level of waste minimization practices in Bauchi construction industry. Reuse on site with the highest mean of 3.86 is in the high category and ranked first. Most of the respondents reuse on site compared to leave at the site which have the lowest mean of 1.70 in the Low category and ranked last. The reuse on site is the most frequent practice on construction site. The reason behind this is because, when the reuse on site is carried out, the production of waste will be reduced as supported by Ahmad *et al.*, (2014). He stated that the most popular practices at construction site are reused on site. The second ranked mean is 3.57 also in the High category which represent the proportion of respondents that minimize waste at the source of origin. This practice is highlighted by Esin & Cosgun. (2007), as the most effective method which primarily prevent waste generation and reducing it as much as possible. This will reduce the reuse, recycling and disposal needs thus providing economic benefits.

In the Moderate category, disposal to landfill is ranked three (3) with a mean of 3.07. This indicated that a reasonable proportion of the waste is taking to landfill which is not a good practice as mentioned by Olaadisa *et al.*, (2015) saying that most waste is disposed of indiscriminately in dump sites and landfills which implies that only a fraction of construction waste is actually recycled. In this category, Sale to another person, disposal off site and reuse off site were ranked fourth, fifth and sixth with a mean of 2.76, 2.59 and 2.54 respectively. When the waste is sold to another person it can be reused or recycled which is a good practice but disposal off site is not a god practice.

In the low category, give to another person, recycle off site, recycle on site, buried at site, buried off site, burning on site and leave at site have a mean: 2.49, 2.31, 2.26, 2.01, 2.01, 1.99, and 1.70 which ranked; 7, 8, 9, 10, 11, 12 and 13 respectively. In this category, the level of recycle is low. This showed that there is a need for proper application of recycling practice as supported by Akinkurolere & Franklin (2005) and Olaadisa *et al.*, (2015). Most of the practices in low category are not good practices to be carried out on the construction site.

Table 3: Rating of the level of practices of waste minimization

Management practices	Very low		Low		Moderate		High		Very high		Total	Weighted mean	Rank
	Freq.	%	Freq	%	Freq	%	Freq	%	Freq	%			
Reuse on site	2	2.86	8	11.43	16	22.86	16	22.85	28	40.00	70	3.86	1
Minimizing at source	3	4.29	6	8.57	22	31.43	26	37.14	13	18.57	70	3.57	2
Disposal to landfill	3	4.29	21	30.00	20	28.57	20	28.57	6	8.57	70	3.07	3
Sale to another person	9	12.86	21	30.00	20	28.57	18	25.71	2	2.86	70	2.76	4
Disposal off site	13	18.57	23	32.85	16	22.86	16	22.86	2	2.86	70	2.59	5
Re-use off site	13	18.57	24	34.29	16	22.86	16	22.86	1	1.43	70	2.54	6
Give to another person	11	15.71	30	42.86	14	20.00	14	20.00	1	1.43	70	2.49	7
Re-cycle of site	23	32.86	20	28.57	12	17.14	12	17.14	3	4.29	70	2.31	8
Recycle on site	22	31.43	20	28.57	17	24.29	10	14.29	1	1.43	70	2.26	9
Buried at site	32	45.71	17	24.29	10	14.29	10	14.29	1	1.43	70	2.01	10
Buried off site	33	47.14	17	24.29	10	14.29	10	14.29	0	0.00	70	2.01	11
Burning on site	31	44.29	20	28.57	9	12.86	9	12.86	1	1.43	70	1.99	12
Leave at site	33	47.14	16	22.86	10	14.29	10	14.29	1	1.43	70	1.70	13

Conclusion

Reuse on site and Minimizing waste at source of origin emerged to be the most significant variables as in Table 3. This shows that the study emphasized the Reuse is the most acceptable way of waste minimization in construction site in the study area. From the findings of this research study, it is recommended that the construction firms should have waste management plan regardless of its size as this will reduce both physical and non-physical waste and increase the profit. The study finally recommended recycling of construction waste as a viable option in construction waste minimization.

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