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Awareness and Usage of Environmental Waste Management Practices (EWMP) of Contractors on construction sites

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Abstract

Construction wastes pose challenges to contractors and clients of construction projects globally, with significant negative consequences on the environment. This study, therefore, investigates the environmental waste management practices (EWMPs) of contractors on construction sites. The objectives are to determine the level of awareness and adoption of MPs. The population of the study was construction professionals on sites in Lagos State, Nigeria. The random sampling technique was used to select 63 companies out of the 126 construction companies in categories C, D and E of firms registered with Lagos State Public Procurement Agency. The targeted respondents were construction professionals in the selected companies. The questionnaire was used to collect data from respondents. Descriptive statistics tools, including mean, percentage and frequency, were used for analysis. The study's findings reveal that contractors are aware of about 28 out of the 47 EWMPs identified from the literature. These include good site materials storage, ordering an exact amount of materials and checking deliveries properly. It also reveals the strategies that are not used as belonging to material exchange/recyclers' association; polluter pays principle, usage of self-contained mini or mobile concrete crusher. It is concluded that although contractors are aware of 28 EWMPs, 26 EWMPs are used on construction sites which are 60% and 55%, respectively. It implies that awareness determines the usage of the MPs. The implications are that if the awareness of EWMPs is increased, the implementation among construction contractors will be improved. It is therefore recommended that professionals should increase their awareness and usage of the neglected EWMPs. This can be achieved through construction firms, governments and institutions sponsoring the training of professionals on MPs. Also, polluter pays principle and recyclers' association should be enforced in project implementations. This can be achieved through government legislation and government regulatory policies for project procurements.

Keywords: Awareness; Best practices; Construction sites; Nigeria; Waste management.

1. Introduction

Advancement in the use of machinery has depleted certain natural resources. Additionally, air and water pollution, greenhouse gas emissions, global warming, and deforestation are few severe industrialisation threats to humanity (Grimms, 2014). The continual growth of inhabitants and industrialisation in developing countries necessitates more homes and offices (Ishola, Ojo & Olaoluwa, 2015). As a result, waste generation has increased in developing countries due to a wide range of construction projects to provide additional infrastructure (Kareem, Asa & Lawal, 2014; Kolawole, 2002 cited in Jimoh, 2012). Waste generation has serious negative environmental impacts making its management necessary to have a healthy environment (Kofoworola, 2006; Chandrakanthi, Hettiaratchi, Prado & Ruwanpura, 2002 cited in Oladiran, 2008; Kareem et al., 2014; Musa, Ashiru & Jibrin, 2015). Construction wastes (CW) are useless materials from construction activities and sites. Environmental wastes (EW) are unfit substances that are discarded or disposed to the environment. Environmental waste management practices (EWMP) in construction projects are methods and strategies engaged by

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construction organisations to minimise the generation and disposal of waste from projects to the environment. Waste Management (WM) engages processes to reduce construction waste volume at landfill through potential waste streams identification, setting goals for materials recovery and ensuring that a range of benefits is met (Kareem et al., 2014). However, environmental waste management practices (MPs) are not uniform; different waste management concepts vary between countries or regions, urban to rural (Tam & Lu, 2016; Demirbas, 2010). Construction waste minimisation (CWM) is a part of sustainable growth and stimulation from the rising concern for the effect of man's actions on the environment (Dania, Kehinde & Bala, 2007). However, in developing countries such as Nigeria, site practices are loose and environmental control is weak, which results in negative environmental consequences (Ishola et al., 2015). Therefore, it is opined that the awareness of EWMPs among professionals is key to their implementation on a construction project. Previous studies focused on a different specific category of EWMP and not holistic (Oladiran, 2009; Kareem et al., 2014; Ishola et al., 2015). Thus, this study seeks to encompass more EWMPs categories for a comprehensive investigation. The problem this study seeks to solve is the environmental hazard of the waste generated from construction activities. The study aims to investigate the EWMPs of contractors on construction sites in Lagos State, Nigeria, to minimise the negative effects of waste on the environment. The specific objectives are to determine the awareness of EWMPs by construction professionals and to ascertain the extent of usage on construction sites in Nigeria. The significance of this study is that it will bring to light the extent of awareness and usage of environmental waste practices by contractors to minimise the environmental impacts of waste from their site.

2. Environmental Waste Management Practices in Construction Projects

Previous studies have investigated several EWMPs that construction contractors can use. Some of them include:

Zero waste: Best waste management practice ensures 'no waste', but construction production is complex; hence designing out waste is affected by many variables and restraints (Andy et al., 2002 cited in Oladiran, 2008). Zero waste philosophy ensures that products are designed to be repaired, refurbished, remanufactured and reused (Zafar, 2018). In addition, zero-waste guides waste elimination (Snow and Dickinson, 2001 cited in Davidson, 2011). There are five zero-waste design principles, including efficient procurement, materials optimisation, offsite construction, reuse and recycling, and deconstruction and flexibility (Zero Waste Scotland, n.d.)

ISO 14001: 1S014001 is a worldwide agreed standard that sets out the requirements for the environmental management system (EMS) (International Standard Organisation (ISO), 2015). The first 1S014001 standards were published in 1996 (Christini et al., 2004). An EMS that separates quality, environmental, health and safety management will lead to redundancy of tasks and information collection, but 1S014001 is an EMS that can possibly integrate policies, documentation, data collection, audit, environmental, and health and safety management system, which saves time with an improvement on risk assessment (Griffith, 2000 cited in Christini et al., 2004). ISO14001 makes firms advance their environmental performance voluntarily (Shen and Tam, 2001), and construction companies can mitigate the negative impacts associated with site activities (Christini et al., 2004; Ishola et al., 2015). Dania et al. (2007.) revealed no specific government legislation on wastes for construction sites in Nigeria and that respondents considered project goals of timely project delivery, quality and cost as more important than the impact of the project on the environment. Ishola et al. (2015) revealed that Nigerian contractors are not 1S014001 compliant. Similarly, Chen et al. (2004) found that construction firms in China do not use 1S014001. Christini et al. (2004), Kofoworola (2006), Ishola et al. (2015) recommend that construction companies in Nigeria should be mandated to develop environmental management policy and embrace implementing complete EMS. Similarly, Chen et al. (2004) recommend adopting IS014001-based EMSs for major construction firms in China and that waste minimisation is achievable using the ISO family's standards, policies, and regulations. 1S014001 implementation requires organisational objectives, greater commitment from the principals, stakeholders along the construction supply chain, designated waste management officer, staff training (ISO, 2015). The benefits of using 1S014001 are but not limited to improvement on firms' environmental performance voluntarily (Shen and Tam, 2001). 1S014001 can be integrated into existing the ISO family such as ISO9001 and ISO45001.

Waste Management Plans (WMPs): Site Waste Management Plans (SWMPs) are legal and compulsory requirements in some parts of the UK for projects with a worth of £300,000 and above (NetRegs, n.d.; Waste and Resource Action Programme (WRAP), n.d.; Papargyropoulou et al., 2011). In Southern Wales and Northern Ireland, the employment of an SWMP specialist for effective management of materials is legally mandatory (NetRegs, n.d.); with this law in the UK, clients must produce Site Waste Management Plans before the commencement of the project. In Nigeria, the findings of Oladiran (2009); Wahab and Lawal (2011) revealed that Waste Management Plan is not a tender document; the studies recommend the inclusion of Waste Management Plan among tendering documents. Oladiran (2009) examined the rate of use of Waste Management Plans and the effects of WMP on construction projects in Nigeria. Oladiran (2009) revealed that WMPs are averagely applied on Nigerian construction projects and that the effects of WMP on materials, labour and time waste minimisation is average but high on equipment waste minimisation. Papargyropoulou et al. (2011) conducted a preliminary exploratory exercise to weigh the Malaysia Construction Industry's level of awareness and commitment to sustainable waste management; the study found that the levels of awareness and adoption of SWMPs are low in Malaysia.

A typical SWMP contains detailed information of the licensed waste carrier, the waste types, quantities and actions taken on the waste, completion of consignment and transfer papers and licensed disposal sites (NetRegs, n.d.). In the UK, the completion of transfer notes before waste leaves the site and the use of waste carriers with valid waste carrier registration certification is a way of staying on the right side of the law (NetRegs, n.d.; Papargyropoulou et al., 2011; Cox, 2016). Scottish Environmental Protection Agency (SEPA) must be notified if waste is hazardous or if waste is dumped indiscriminately (NetRegs, n.d.). In Lagos, wastes, including construction wastes, are dumped around streetlight poles and roads embankments (Ajayi et al., 2008). Kofoworola (2006) concluded that inhabitants dump waste indiscriminately because there are no distinct waste collection points. Papargyropoulou et al. (2011) reported a lack of practical tools and relevant infrastructures as among the barriers to adopting SWMPs. Sapuay (2016) found that construction waste or materials finish up as dumps in the surrounding due to inadequate supervision. On the other hand, Gangolells and Macarulla (2014) revealed that in Catalonia, Spain, the designed waste infrastructure is five times more than waste generated. However, Gangolells and Macarulla (2014) found that one of the least widespread practices of the Catalonian construction companies was disseminating the SWMP contents to workers to help them meet the plan's requirements. Papargyropoulou et al. (2011) recommend an investigation into practices for adoption and the development of National standard SWMPs for Malaysia.

Waste sorting: Identification of waste composition is also essential for an efficient waste management process due to the amount of reusable waste (Oladiran, 2008). Waste is characterised as solid, liquid and air pollutants, each typically managed, regulated differently (Woodward and Curran Inc., 2006 cited in Davidson, 2011). Each group has different methods of disposal and management, hence the need for sorting ("waste management", n.d.). For instance, site waste composition includes asphalt, concrete, metal, wood, claystone paper, cement, concrete and woodpile (Heltiaratchi et al., 1997 cited in Oladiran, 2008). The construction process of a 13 storey office building project in the UK emitted 651 tons of CO_2 with 73% from electricity and 27% from fuel usage (Skanska, 2010 cited Ishola et al., 2015). There is also construction dust from stone, cement, bricks, wood or concrete (Health & Safety Executive (HSE), n.d.). The five largest toxic air emissions from construction are Sulphur dioxide (SO_2), nitric dioxide (NO_2), volatile organic compounds (VOC), toxic releases to air and hazardous waste generated (Hendrickson and Horvath, 2000). Chen et al. (2004) posit that sources of pollution and hazard from construction activities in China could be sorted into seven major types, dust, harmful gases, noises, solid and liquid wastes, falling objects and ground movement. Solid waste types from construction and demolition works are wood, steel, concrete, dirt, bricks and tiles (Hoornweg and Bhada-Tata, 2012). Kofoworola (2006), Wahab and Lawal (2011), Kareem et al. (2014) revealed that sorting is not done on construction sites in Nigeria. Scavengers sort waste on dumpsites (Kofoworola, 2006); sorting is not done as a result of non-availability of space on-site (Wahab and Lawal, 2011), operatives perceive waste management issues as an extra burden (Kareem et al., 2014).

Waste recycling and recovery: Kofoworola (2006) and Ajayi et al. (2008) revealed that most construction waste in Lagos State is not recycled. Ajayi et al. (2008) confirm that little attention is given to recycling and that most construction waste from demolition and renovation works are disposed of aimlessly in dumpsites and landfills. Kareem et al. (2014) also revealed that contractors or operatives lack the practice of reuse or recycling materials on site. Sapuay (2016) concludes that most construction sites concentrate on sanitary maintenance within their sites with no EWMPs that consider reuse, recycling and resource recovery. Excess materials from the construction process or residual from demolition can still be useable should the contractor exert efforts in finding ways to use them rather than dispose of them. Though appearing the cheapest, landfills are practically expensive and can be impossible because areas with the largest solid waste generation are also the areas with serious land scarcity problem (Kofoworola, 2006). Waste landfills or dumps occupy valuable land; worse still, landfills are hideous and sources of environmental hazards (Ajayi et al., 2008). Ajayi et al. (2008) opine that reuse and recycling prevent pollution and environmental impacts of waste. Reducing, reusing and recycling waste are profitable alternatives that will increase the lifetime of landfills and reduce the exploitation of natural resources. Compact self-contained mini or mobile crusher for demolished concrete can be used on-site; the advent of crusher attachments allows the connection of concrete crushers to various construction equipment such as excavators. Kareem et al. (2014) found that metal was the only material worth recycling on-site; comparatively, little income is generated from recycling most other building materials. Reclaimed materials sold on landfills are metals, copper, aluminium, lead, blast iron paper, plastic, polyvinyl, plastic bottles, glass and so on (Kofoworola, 2006). Kofoworola (2006) reports were on landfills while Kareem et al. (2014) were on construction sites; this suggests that fewer materials are recovered or recycled on the construction sites.

Revitalisation: Revitalisation is a waste management practice that assures that there are no leftover waste on-site. It involves neutralising chemically harmful materials on-site, then replanting trees and vegetation. For example, certain construction waste materials usually contain leads, asbestos and other hazardous substances. In addition, certain components of construction waste, such as plasterboard once landfilled, are hazardous because it increases hydrogen sulfide, a toxic gas.

Waste Material Recovery Facility (WMRF): WMRF is a specialised plant that accepts, separates and prepares recyclable materials for marketing for end-user manufacturers (Zafar, 2018). The two main MRF types are the dirty type which accepts mixed waste, and the clean type, which does not. Hong Kong has a WMRF since 1998 (Ming-Zhi and Gao, 2006) cited in (Wahi et al., 2015). After launching the offsite construction waste sorting (CWS) program, the Hong Kong government built two waste sorting facilities in TuenMun and Tuseng Kwano areas in 2006 (Lu and Yuan, 2012 cited in Wahi et al., 2015). Wahi et al. (2015) reported that the practice of waste sorting has improved after the construction of the recycling facilities and the enforcement of polluters pay policy; this implies that there is a need for structures to be brought nearer to the people and government initiatives to ensure the adoption of environmental friendly WMPs. Kofoworola (2006) reported that there was no single official waste WMRF in Nigeria; the study recommends the development of environmental policies for recovery and recycling promotion in Lagos state and the recovery of landfill gas (LFG) for energy generation. A former Lagos State Governor, Mr Babatunde Fashola SAN, commissioned a N1.3 billion Solid Waste MRF in Alimosho Local Government Area, in Lagos State on 12th of May 2015 ("Fashola commissions N1bn recycling plant in Igando", 2015). The facility is the first of its kind in Nigeria; in the 1st phase, the facility will require about130 trucks of waste on a daily basis to process different waste types into raw materials for plastic and rubber industries ("Fashola commissions N1bn recycling plant in Igando", 2015). In the 2nd, electricity will be produced from heat energy of more tons of waste, and the 3rd will include the production of composts for fertilisers to maintain gardens (Lagos State Governor's Office, 2015). Ex. Governor Mr Babatunde Fashola said that the facility is a conservation strategy to tackle the climate change threats and demonstrate the State Government's commitment to improving the environment and creating economic benefits ("Fashola commissions N1bn recycling plant in Igando", 2015). Dubanowitz (2000) investigated the design and operation of a 150tons/day (876000tons/yr) facility for New York recyclables; the study posits that the facility would save $46million for the city waste management yearly. As the construction industry meets the growing human needs, the environment and the natural resource essential for development must be protected and conserved. WMRFs also process wastes into feedstock for biological conversion (Gheewala and Nielsen, 2003 cited in Kofoworola, 2006).

3. Research Method

A survey research design was used for this study. It was used because it enables the gathering of data from the respondents at a time to provide answers to the research objectives. The area of study was Lagos State. Lagos State is the second most populous state in Nigeria; the population is estimated at 17,552,940 (2012 census conducted by LASG) and population density of 2,500/Km2. Lagos State is one of the most economically vibrant states, a major financial centre and fifth largest economy in Africa ("Lagos State", 2019). The GDP per capita is $4,333 ("Lagos State", 2019). The population of the study is the construction firms in Lagos State, while the sampling frame comprises of those registered with the Lagos State Public Procurement Agency, categories C, D and E. The targeted respondents are construction professionals in the firms. The population size of the frame is 126 construction firms were identified, out of which 63 were randomly chosen for the study.

A structured questionnaire was used to collect data from the respondents. The questionnaire had two sections, A and B. Section A focuses on the demographic information of the respondents. Section B investigates the awareness and usage of a set of EWMPs on sites coined from literature, using a 5-point Likert scale. The questionnaires were administered to the construction professionals in the 63 selected firms, out of which responses were received from 57 and used for the study. Validity is defined as the degree to which a measuring instrument measures what it is designed to measure. It is the ability of the instrument to measure what it is supposed to measure. Academic scholars revealed the errors in the questionnaires and were adjusted to ensure validity. Reliability is defined as the consistency between independent measurements of the same phenomenon. It is the stability, dependability and predictability of a measuring instrument. It connotes the accuracy or precision of a measuring instrument. The coefficient alpha, otherwise known as Cronbach's Alpha reliability, was calculated for the data used in the study. The average Cronbach's Alpha reliability value was 0.850. This is significantly more than the satisfactory 0.7, and 0.6 values recommended in Robson (2000) and Azika (2004), respectively. It implies that the data used are adequately reliable. Mean and frequency was used to analyse the data.

4. Findings and Discussion

4.1 Demographic information

The organisations' and respondents' profiles are presented in Table 1.

Table 1: Demographic Information

	Desciption	**Frequency**	**%**
Respondents	Architects	15	27.3
	Builders	9	16.3
	Civil Engineers	20	36.4
	Mechanical Engineers	1	1.8
	Quantity Surveyors	10	18.2
	Total	**55**	**100**
	Educational Qualification		
	HND	9	16.1
	B.Sc.	27	48.2
	PGD	2	3.6
	M.Sc.	18	32.1
	Total	**56**	**100**
	Professional Membership		
	NIA	11	20.4
	NIOBE	8	14.8
	NSE	21	38.9
	NEWS	8	14.8
	NONE	6	11.1
	Total	**54**	**100**
	Experience		
	0 – 5	9	15.8
	6 – 10	18	31.6
	11 – 15	15	26.3
	16 – 20	6	10.5
	Over 20years	9	15.8
	Total	**57**	**100**
Organisations	**Category**		
	< ₦100M	2	3.6
	₦100M<₦300M	9	16.1
	₦300M<₦1B	10	17.9
	₦1B< ₦10B	17	30.4
	₦10M and above	18	32.1
	Total	**56**	**100**

Ownership		
Expatriate	13	22.8
Indigenous	44	77.2
Total	**57**	**100**
Type		
Contracting	**51**	89.5
Consulting	5	8.8
Client	1	1.8
Total	**57**	**100**

The professions of the respondents shown in Table 1 reveals that 27.3% of them are Architects, another 16.3% are Builders, 1.8% are Mechanical Engineers, 36.4% are Civil Engineers, and 18.2 % are Quantity Surveyors. About 16% of them holds higher national diploma (HND) degree, 48.2% holds B.Sc. degree, 32% holds M.Sc. degree and 3.6% holds postgraduate diploma (PGD) degree. Close to 16% each of the respondents' work experience were between 1 to 5 years, and above 20 years, 31.6% were between 6 to 10 years, 26.3% were between 11 to 15 years, and 10.5% were between 16 to 20 years. More than 20% of them were members of the Nigerian Institute of Architects (NIA), 14.8% each of the Nigerian Institute of Quantity Surveying (NIQS) and Nigerian Institute of Building (NIOB), about 39% of the Nigerian Society of Engineers (NSE) and 11% did not indicate whether they were members of any professional body. Additionally, 89.5% were contracting organisations, 8.8% were consulting, and 1.8% was a client organisation. Just 3.6% of the organisations belong to the category that is < N100 million project capability, 16% belong to N100m - < N300 million, 18% belong to N300million - < N1billion, 30.4% belong to N1billion - < N10 billion, and 32% belong to N10 billion and above project capability. About 77% of the organisations were fully indigenous organisations, while 23% were fully expatriate. It can be inferred that the respondents from these organisations can supply the needed information for the study.

4.2 Awareness of Environmental Waste Management Practices

The mean of items listed as EWMP was used to rank the awareness of respondents in order to determine the level of awareness of EWMPs on construction sites by Nigerian contractors in Lagos State. The result of the analysis is presented in Table 2. Respondents were asked to indicate their awareness of 47 EWMPs using a 5-point Likert scale.

Table 2: Awareness of Environmental Waste Management Practices

S/N	Environmental Waste Management Practices	N	1	2	3	4	5	STD	Mean	GR	OR
Zero Waste									**3.70**		
1	Good site material storage practice	57	0	0	6	26	25	.664	4.33	1	1
2	Ordering the required amount of materials as accurately as probable	56	0	1	5	25	25	.716	4.32	2	2
3	Checking deliveries for any shortages and or damages	57	0	3	5	23	26	.835	4.26	3	3
4	Just in time delivery for a reduction in storage and materials losses	57	0	3	13	31	10	.774	3.84	4	6
5	Use of site materials control	57	0	3	13	31	10	.774	3.84	4	6
6	Use of fabrication, offsite prefabrication	57	2	2	21	22	10	.938	3.63	6	9
7	Use of standard and realistic components	57	4	3	15	23	12	1.096	3.63	6	9
8	No 'throwing away waste'	57	5	7	14	22	9	1.163	3.40	8	14
19	Designing out waste at the earliest stage of the construction process	56	2	11	15	20	8	1.071	3.38	9	16
10	Minimising temporary works	56	0	10	28	14	4	.825	3.21	10	20
11	Use of recyclable materials	57	4	16	22	11	4	1.023	2.91	11	30
ISO 14001									**3.01**		
12	Top management commitment	57	3	10	13	22	9	1.117	3.42	1	13
13	Organisational waste objectives	56	5	9	21	13	8	1.146	3.18	2	21
14	Sources of materials considered if the company is certified with environmental standards	56	6	7	22	16	5	1.096	3.13	3	23
15	Supply chain impact by communicating environmental impacts to suppliers	56	6	12	20	15	3	1.069	2.95	4	29
16	Using designated waste management officer	57	13	13	14	10	7	1.330	2.74	5	32
17	Staff training on waste	57	12	15	16	9	5	1.232	2.65	6	40
Waste management plans (WMPs)									**2.81**		
18	Disposal at licensed sites	57	4	11	14	20	8	1.149	3.30	1	19
19	Sanctions for poor waste disposal	57	2	18	15	18	4	1.033	3.07	3	28
20	Information about the client, the principal contractor, the person that drafted the SWMP	57	5	18	19	12	3	1.037	2.82	4	31
21	Estimation and waste management action for each waste type	57	7	19	14	16	1	1.061	2.74	5	32
22	Use of waste carriers with valid waste carrier registration certification	57	8	16	19	13	1	1.034	2.70	6	35
23	Completion of consignment note before waste leaves the site	57	9	20	15	12	1	1.051	2.58	7	41
24	Completion of transfer notes before waste leaves the site	57	11	17	21	7	1	1.002	2.47	9	45
Waste Sorting									**2.85**		
25	Separation of inert and non-inert wastes on sites	57	1	10	32	9	5	.867	3.12	2	24
26	Designated skips for different materials	57	8	19	22	5	3	1.017	2.58	7	41
Waste accommodation/storage									**3.71**		

27	High quality of housekeeping on site	57	1	3	12	17	24	1.007	4.05	1	4
28	Site plan showing waste storage points	57	4	6	24	11	12	1.144	3.37	2	17
Waste Collection and Transportation									**3.43**		
29	Waste packed manually into waste trucks	57	1	4	14	23	15	.996	3.82	1	8
30	Loading of waste truck mechanically	57	1	7	25	16	8	.942	3.40	2	14
31	Waste collection planning	56	5	8	16	16	11	1.212	3.36	3	18
32	Use of hydraulic compactor	57	6	6	27	11	7	1.103	3.12	4	24
Waste recycling and recovery									**2.59**		
33	Reuse: conversion of the waste stream into reuse pathway	56	6	20	19	7	4	1.060	2.70	1	35
34	Reduction or recycling of the packaging for materials delivered	57	9	18	18	6	6	1.183	2.68	2	37
35	Recycle: recovery of the value of waste stream for recycling purpose	57	8	18	19	9	3	1.075	2.67	3	38
36	Use of compact, self-contained mini crushers or mobile crusher for demolished concrete	57	14	20	15	7	1	1.038	2.32	4	46
Revitalisation									**2.89**		
37	Replanting trees and vegetation.	57	5	14	17	12	9	1.205	3.11	1	26
38	Neutralisation of chemically harmful materials on site	57	8	17	19	12	1	1.024	2.67	2	38
Waste incineration									**2.72**		
39	Waste is transported to an incinerator	57	12	13	14	15	2	1.221	2.72	1	34
Waste Material Recovery Facility									**2.49**		
40	Waste is transported to Waste Material Recovery Facility	57	9	16	28	3	1	.889	2.49	1	44
Waste Behaviour									**3.33**		
41	Awareness of the consequences of waste and taking personal responsibility for others' well being	57	3	5	20	18	11	1.071	3.51	1	11
42	Cost savings from waste reduction made beneficial to all site management staff	57	5	6	26	16	4	1.008	3.14	2	22
Air Quality strategy									**3.50**		
43	Dust reduction measures during construction	57	2	1	11	29	14	.912	3.91	1	5
44	Maximum level of emission is considered for development application approval in each local council	57	6	7	24	16	4	1.057	3.09	2	27
Vegetation preservation									**3.46**		
45	Preservation of existing vegetation	56	1	9	20	15	11	1.044	3.46	1	12
Polluter pays principle									**2.56**		
46	Requirement for a waste generator to pay for appropriate disposal of unrecoverable material (Extended responsibility to the material manufacturer).	57	6	24	18	7	2	.964	2.56	1	43
Building materials exchange/ recycler's association									**1.82**		
47	Belong to a material exchange/recyclers' association	56	25	19	9	3	0	.897	1.82	1	47

N= total respondents, 1 represents Not aware, 2 represents Slightly aware, 3 represents Moderately aware, 4 represents Highly aware, 5 represents Very highly aware, mean, GR= Group Ranking, OR= Overall Ranking.

The criterion used to determine the awareness level of EWMPs on construction sites by the respondents are those variables whose mean scores are 3.00 and above, which represents 'moderate awareness' on the scale. The 47 EWMPs were categorised into 15; namely, zero waste, ISO 14001, waste management plans, waste sorting, waste accommodation/storage, waste collection and transportation, waste recycling and recovery, revitalisation, waste incineration, waste material recovery facility, waste behaviour, air quality strategy, vegetation preservation, polluter pays principle and building materials exchange/recycler's association. The following can be observed from Table 2:

Zero waste: the respondents are aware of the strategies in this category except for the use of recyclable materials (2.91). This result supports the conclusion of Ajayi et al. (2008); Wahab and Lawal (2011) that recycling is a rare practice in Nigeria. The first three highest-ranked practices are good site material storage practice, ordering the required amount of materials accurately and checking deliveries for shortages and damages with means of 4.33, 4.32 and 4.26, respectively. It has confirmed the assertion that contractors are more interested in issues that will affect the project cost; the construction industry is not ignorant of the need to consider the environment, but their focus is different.

ISO 14001: the first two highest-ranked under ISO 14001category are top management commitment and organisational waste objectives with mean scores of 3.42 and 3.18, respectively. This indicates that the importance of top management on EWMPs is acknowledged by the respondents.

Waste management plans: respondents are not aware of almost all practices under this category. However, disposal at licensed sites ranked highest (3.30). Further questioning revealed that most times, contractors do not measure or take cognisance of the waste being removed from their sites, and this can be the reasons for their unawareness of completion of consignment and transfer notes before waste leaves the site and other practices within waste management plans category.

Waste sorting: it can be observed that respondents are aware of the separation of inert and non-inert wastes on sites (3.12). However, respondents are not aware of designated skips for different materials (2.58).

Waste Collection and Transportation: respondents are aware of all practices under this category since contractors must ensure that waste is packed and evacuated from their sites.

Waste recycling and recovery: respondents are not aware of all the four strategies under this category. This finding validates the work of Wahab and Lawal (2011) that reuse and recycling are new practices in Nigeria.

Revitalisation: respondents are not aware of the neutralisation of chemically harmful materials on site (2.67) but are aware of replanting trees and vegetation (3.11). Further questioning revealed that neutralisation of chemically harmful materials on site is not really a needed practice on c as respondents do not deal with many chemicals on sites. The awareness of replanting trees and vegetation is heightened through the greener initiatives of programmes of Lagos State Government.

Waste incineration: respondents are not aware of waste incineration (2.72). As earlier mentioned, the removal of construction waste from their sites is usually outsourced. Incineration is one of the treatments on construction waste after leaving sites.

Waste material recovery facility: it can be observed that transportation of waste to waste material recovery facility has a low level of awareness (2.49). This could be because waste recovery is new.

Waste Behaviour: it was discovered that most respondents are aware of waste consequences and taking responsibilities for others well-being (3.51), and cost savings from waste reduction made beneficial to all site management staff (3.14) under this category. The awareness of waste behaviour may be due to health and safety concerns on sites.

Air Quality strategy: Most of the respondents are aware of dust reduction measures during construction (3.91), and the maximum level of emission is considered for development approval in each local council (3.09) under this category. Further questioning revealed that some legislation directs operational approaches, such as equipment types that can be used to limit environmental disturbance. It can be implied that Government legislation has aided the awareness of the two practices in this category.

Vegetation preservation: the respondents are aware of the preservation of existing vegetations (3.46). Further questioning revealed that the awareness had been heightened through the greener Lagos initiatives programme of the Lagos State Government.

Polluter pays principle: this principle requires that waste generators pay for disposal of unrecoverable waste. It was found out that the respondents are not aware of it (2.56). It ranked 43rd in the overall ranking of the 47 practices.

Building materials exchange/recyclers' association: the awareness of this practice is low among the respondents (1.82). In Nigeria, it is scavengers that recycle building materials (Kofoworola, 2006).

In conclusion, out of the 15 EWMPs categories, the respondents are aware of seven categories - waste accommodation and storage (3.71), zero-waste (3.70), air quality strategy (3.50), vegetation preservation (3.46), waste collection and transportation (3.43), waste behaviour (3.33) and ISO 14001 (3.01). It can be observed that they are not aware of the remaining eight categories of EWMPs because their overall means are less than 3. Similarly, out of the 47 MPs, the respondents are aware of 28 EWMPs, the EWMP with the highest level of awareness is Good site material storage while Belong to a material exchange/recyclers association is the least.

4.3 Usage of Environmental Waste Management Practices

The mean of items listed as environmental waste management practices was used to rank the usage of the practices by the respondents in order to determine the application of the environmental waste management practices on construction site by Nigerian contractors. Respondents were asked to indicate their implementation of 47 EWMPs using a 5-point Likert scale. The criterion used to determine applied EWMPs on construction site by the respondents are those variables whose mean scores are 3.00 and above, which represents 'average usage' on the scale. The 47 EWMPs were categorised into 15; namely, zero waste, ISO 14001, waste management plans, waste sorting, waste accommodation/storage, waste collection and transportation, waste recycling and recovery, revitalisation, waste incineration, waste material recovery facility, waste behaviour, air quality strategy, vegetation preservation, polluter pays principle and building materials exchange/recycler's association.

Table 3: Usage of environmental waste management practices

S/N	Environmental Waste Management Practices	N	1	2	3	4	5	STD	Mean	GR	OR
Zero Waste									**3.67**		
1	Good site material storage practice	57	0	0	6	27	24	.659	4.32	1	2
2	Checking deliveries for any shortages and or damages	57	0	1	9	22	25	.786	4.25	2	3
3	Ordering the required amount of materials as accurately as probable	57	0	2	13	20	22	.872	4.09	3	4
4	Use of site materials control	57	0	2	14	28	13	.786	3.91	4	5
5	Just in time delivery for a reduction in storage and materials losses	57	0	7	12	25	13	.945	3.77	5	7
6	Use of fabrication, offsite prefabrication	57	0	3	22	21	11	.844	3.70	6	8
7	Use of standard and realistic components	57	0	5	18	29	5	.776	3.60	7	11
8	Designing out waste at the earliest stage of the construction process	57	2	9	14	28	4	.961	3.40	8	14
19	Minimising temporary works	57	1	9	30	12	5	.875	3.19	9	18
10	No 'throwing away waste'	57	7	9	17	19	5	1.160	3.11	10	23
11	Use of recyclable materials	57	4	10	29	7	7	1.042	3.05	11	25
ISO 14001									**2.92**		
12	Top management commitment	57	2	13	13	22	7	1.075	3.33	1	16

13	Organisational waste objectives	57	4	11	22	17	3	.997	3.07	2	24
14	Sources of materials considered if the company is certified with environmental standards	57	6	9	25	12	5	1.077	3.02	3	26
15	Supply chain impact by communicating environmental impacts to suppliers	56	4	16	19	16	1	.966	2.89	4	28
16	Staff training on waste	57	8	18	17	9	5	1.158	2.74	5	32
17	Using designated waste management officer	57	11	21	15	7	3	1.104	2.47	6	41
Waste management plans (WMPs)									**2.75**		
18	Disposal at licensed sites	57	7	10	15	18	7	1.217	3.14	1	20
19	Sanctions for poor waste disposal	57	4	10	24	12	7	1.076	3.14	1	20
20	Use of waste carriers with valid waste carrier registration certification	57	10	11	21	12	3	1.134	2.77	3	31
21	Information about the client, the principal contractor, the person that drafted the SWMP	57	16	11	15	9	6	1.333	2.61	4	36
22	Estimation and waste management action for each waste type	57	13	17	10	14	3	1.237	2.60	5	37
23	Completion of consignment note before waste leaves the site	57	12	15	21	6	3	1.104	2.53	6	39
24	Completion of transfer notes before waste leaves the site	57	12	18	17	8	1	1.042	2.43	7	44
Waste Sorting									**2.79**		
25	Separation of inert and non-inert wastes on sites	57	2	15	30	7	3	.859	2.89	1	28
26	Designated skips for different materials	57	3	24	20	8	2	.909	2.68	2	34
Waste accommodation/storage									**4.05**		
27	High quality of housekeeping on site	57	2	14	24	16	1	4.063	4.49	1	1
28	Site plan showing waste storage points	57	2	5	19	19	12	1.033	3.60	2	11
Waste Collection and Transportation									**3.33**		
29	Waste packed manually into waste trucks	56	1	0	17	29	9	.773	3.80	1	6
30	Waste collection planning	57	1	10	23	14	9	1.009	3.35	2	15
31	Loading of waste truck mechanically	57	0	8	29	18	2	.739	3.25	3	17
32	Use of hydraulic compactor	57	3	10	35	6	3	.842	2.93	4	27
Waste recycling and recovery									**2.44**		
33	Reduction or recycling of the packaging for materials delivered	57	10	19	15	5	8	1.270	2.68	1	34
34	Reuse: conversion of the waste stream into reuse pathway	57	6	23	22	4	2	.908	2.53	2	39
35	Recycle: recovery of the value of waste stream for recycling purpose	57	7	23	20	7	0	.868	2.47	3	41
36	Use of compact, self-contained mini crushers or mobile crusher for demolished concrete	57	14	27	13	3	0	.830	2.09	4	46
Revitalisation									**2.94**		
37	Replanting trees and vegetation.	57	4	9	25	12	7	1.066	3.16	1	19
38	Neutralisation of chemically harmful materials on site	57	8	12	26	10	1	.978	2.72	2	33
Waste incineration									**2.60**		
39	Waste transported to incinerators	57	9	21	13	12	2	1.100	2.60	1	37
Waste Material Recovery Facility									**2.47**		
40	Waste is transported to Waste Material Recovery Facility	57	7	20	27	2	1	.826	2.47	1	41
Waste Behaviour									**3.37**		
41	Awareness of the consequences of waste and taking personal responsibility for others' well being	57	1	4	19	25	8	.881	3.61	1	10
42	Cost savings from waste reduction made beneficial to all site management staff	57	4	9	22	20	2	.965	3.12	2	22
Air Quality strategy									**3.27**		
43	Dust reduction measures during construction	57	1	3	16	30	7	.827	3.68	1	9
44	Maximum level of emission is considered for development application approval in each local council	57	4	15	24	11	2	.943	2.86	2	30
Vegetation preservation									**3.48**		
45	Preservation of existing vegetation	56	0	8	22	17	9	.934	3.48		13
Polluter pays principle									**2.42**		
46	Requirement for a waste generator to pay for appropriate disposal of unrecoverable material (Extended responsibility to the material manufacturer).	57	12	16	22	7	0	.963	2.42		45
Building materials exchange/ recycler's association									**1.88**		
47	Belong to a material exchange/recyclers' association	57	27	14	12	4	0	.983	1.88		47

N= total respondents, 1 represents Nil level, 2 represents Low level, 3 represents Average level, 4 represents High level, 5 represents Very high level, Mean, GR= Group Ranking, OR= Overall Ranking

The following can be observed from Table 3:

Zero Waste: all the EWMPs under this category are used, but good site material storage practice (4.32) and checking deliveries for shortages and damages (4.25) were the most used practices by the respondents. This agrees with the findings of Adewuyi and Odesola (2016) that the most commonly used waste minimisation strategies on-site are properly securing stores after closing hour daily and checks on deliveries for shortages and or damages. The usage of all practices under zero waste could be owing to the fact that these practices ensure the safety and security of materials against theft, damages and vandalism. It can be implied that physical profit is mostly thought of by construction firms to using EWMPs.

ISO 14001: using designated waste management officer (2.47), staff training on waste (2.74), and supply chain impact by communicating environmental impacts to suppliers (2.89) are not used under this category. Further questioning during the survey revealed some respondents' view that EWM usage has cost and time implication; therefore, EWM issues be added in contractual clauses. Top management commitment (3.33) ranking highest is an indication that respondents appreciate the importance of top management. The commitment of top management is essential for EWMPs (Kareem et al., 2014). Other practices that are used in this category are organisation waste objectives (3.07) and sources of materials considered if the company is certified with environmental standards (3.02).

Waste management plans (WMPs): the usage of disposal at licensed sites (3.14) and sanctions for poor waste disposal (3.14) suggests that respondents agree that government legislation can influence the adoption of WMPs; its adoption is backed with legislation in the UK. However, use of waste carriers with valid waste carrier registration certification (2.77), estimation and waste management action for each waste type (2.60), completion of consignment notes before waste leaves the site (2.53), and others are not used. Further questioning revealed that most respondents are not sure of the destination of their waste. It can be implied that waste that leaves sites can be handled and dumped incongruously. Also, no one can be held responsible since the processes are not documented; this practice is a reverse to the duty of care in the UK. Details of duly licensed waste carrier and eventual waste destinations are recorded to ensure duty of care and prevent illegal dumping or other wrong wastes handling (Papargyropoulou et al., 2011). The finding of this study shows that contractors do not use the practices of waste management plans (WMPs) category (2.75). This differs from the findings of Oladiran (2009b) that revealed average use of WMPs on Nigeria construction projects, but it aligns with Papargyropoulou et al. (2011) that revealed a low level of awareness and adoption of SWMPs in Malaysia.

Waste sorting: this category is not used on construction sites (2.79); the two practices examined in this category are not implemented on the sites investigated. Designated skips for different materials is a practice that will require extra resources such as skips, and this can affect the contractors' profit. This finding supports the view of Singaporean contractors who felt that EMS could not be engaged owed to construction costs increase (Ofori et al., 2002) cited in (Ishola et al., 2015). Some respondents claim that value is attached to metals in tons; the metals are carefully sorted out and sold to metal recyclers; this validates Kareem et al. (2014) that individual judgment comes to play as regards value attached to reusable material.

Waste accommodation/storage: Site plan showing storage points (3.60) and high quality of housekeeping on site (4.49) are used. This result agrees with Sapuay (2016) that contractors uphold hygiene on sites by disposing waste away from their operational area. High quality of housekeeping on site is also a health and safety concern, as accidents on sites will cause delay, payment of insurance to the injured or on the dead, and cost on the organisation's reputation and so on. Improper debris management has caused major environmental problems, hazards and accidents (Papargyropoulou et al., 2011).

Waste collection and transportation: this category is used by the respondents (3.33). Contractors' duty is to ensure the removal of construction waste from the site. Waste packed manually into the waste truck (3.80) ranked 1st in this category. However, the use of hydraulic compactor (2.93) ranked least, and this result can be due to the fact that contractors outsource the evacuation of construction waste from their sites, so the mechanical equipment is rarely used by contractors.

Waste recycling and recovery: all EWMPs under this category are not used. This confirms the revelation by Kofoworola (2006) that Governments and waste management authorities in Nigeria give inadequate attention to recycling and resource recovery. Further questioning revealed that most construction and demolition works are usually sub-contracted; at times, construction waste is given out free on-demand by the local community, and the main contractors rarely attach commercial value to construction waste on-site, as the timely removal of the waste is of priority. Contractors are more interested in the management of project deliverables, time, budget and quality. Kamal (2009); Ren et al. (2012) recommend the consideration of 'environment' as an additional criterion for project planning. Some respondents claim that waste generation is avoided through accurate estimation of resources. Waste is inevitable (Wahab and Lawal, 2011), and estimators' allowances for materials waste are usually exceeded (Odusami et al., 2012).

Revitalisation: Neutralisation of chemically harmful materials on site (2.72) is not a practice that is applied. As already mentioned earlier, this result reflects the fact that many toxic elements are not used on construction sites. Replanting trees and vegetation (3.16) is used; this could have been encouraged or enforced through the implementation of the greener initiative programmes of the Lagos State Government.

Waste incineration: this category is not a used EWMP (2.60). As earlier mentioned, the evacuation of waste is mostly outsourced to a third party. Lagos State Waste Management Agency is sometimes employed; however, most respondents are not sure if waste carriers are certified or not; this implies that most respondents neither contribute to the actions taken on their wastes offsite nor aware of the waste destination; this is a defeat to the purpose of EWM. Waste Management (WM) is ensuring that waste is removed from the place of generation, treated and disposed of or recycled safely (Demirbas, 2010). With proper research, a contractual relationship for successful implementation of WM practice can be negotiated with waste service providers (Davidson, 2011). The principles of Waste Material Management must be communicated to design and construction teams and also the WM contractors in order to experience the full benefits of good WMMPs (WRAP, n.d.).

Waste Behaviour: Awareness of the consequences of waste and taking personal responsibility for others' well-being (3.61); and cost savings from waste reduction made beneficial to all site management staff (3.12) are used in this category.

Air Quality strategy: Dust reduction measures during construction (3.86) are used by the contractors on sites, while maximum level of emission is considered for development application is not used (2.86). Further questioning revealed that the State Government regulates the use of equipment on construction sites.

Vegetation preservation: this practice is applied on construction sites (3.48). The usage level must have been heightened because of the Lagos State Government greener initiative programme.

Polluter pays principle: this is not used on construction sites (2.42). The construction waste disposal charging scheme (CWDCS) introduced in Hong Kong in 2006 has made the contractors embrace on-site waste sorting practice, reuse, recycling of C and D waste (Wahi et al., 2015).

Building materials exchange/recyclers' association: this is not a used EWMP on the sites. Belong to a material exchange/recyclers' association ranked least in the overall (1.82). This result indicates that 'building materials exchange' is not trendy among professionals, and this supports Kofoworola (2006) that scavengers pick items for recycling on dumpsites in Lagos. The recycling industry has over 2million informal waste pickers worldwide (Hoornweg and Bhada-Tata, 2012).

5. Conclusions

The study investigates the EWMPs of contractors on construction sites in Lagos. Survey research was used to carry out the study. The following conclusions are drawn on the findings of the study:

1. Contractors are aware of 28 EWMPs and use 26 on construction sites out of 47 EWMPs that were investigated. It implies that the awareness of the EWMPs determines their usage. If the awareness is increased, the implementation will be improved.

2. Waste accommodation/storage practice is the most used EWMPs, while building materials exchange/recyclers association is not a practice among contractors. It implies that a lot of waste will still be generated on sites because storage induces wastages.

6. Recommendations

The following recommendations are based on the conclusions drawn from the findings of the study:

1. Professionals should increase their awareness and usage of some neglected EWMPs. This can be achieved through construction firms, governments and institutions sponsoring the training of professionals on MPs. Seminars and conferences can also be organised by these bodies.

2. Polluter pays principle and recyclers' association should be enforced in project implementations. This can be achieved through governments legislations and policies for project procurements..

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