

Profiling the Environmental Management Practices on Construction Sites in Lagos State, Nigeria

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Abstract

Construction site activities are associated with negative impacts on the environment and construction companies are expected to mitigate these impacts using environmental management practices (EMP) on their sites based on ISO 14001 requirements. However in Nigeria where the construction industry is not regulated, it is imperative to explore if the contractors are ISO 14001 compliant. A systematic random sampling was used to select one hundred and twenty (120) site managers in Lagos state of Nigeria; out of which seventy-three (73) responded. The results of the analysis showed that, none of the construction managers were aware of their companies' environmental management policy, but the three most prevalent environmental management practices (EMP) on construction sites were displaying of posters, inspection by management, planning and organizing site environment in rank order. It was also discovered that, the type of project, availability of a clear company policy on EMP and management attitude towards environmental issues were the most prevalent influential factors that necessitated the adoption of a particular EMP on site. The study therefore recommended that construction companies should be mandated to develop an environmental management plan for project site.

Keywords: Construction, environmental management practice, Nigeria

1. Introduction

The construction industry is a significant economic activity that contributes approximately 10% to the global domestic product of any nation, consumes considerable energy and resources compared to other industrial sectors (Guggemos and Horvath, 2006). The industry is generally defined as economic activities that focus on the construction of physical projects, such as buildings and infrastructure that enable mankind to meet their social needs for shelter, to meet economic needs for investment and satisfy corporate objectives (Ahn *et al.*, 2010; Abidin, 2009).

Due to the perennial growth in human population and urbanization experienced in developing countries the demand for construction projects such as houses, hospitals, schools and offices has greatly increased in recent years. However, in the bid to satisfy these needs little attention is given to its impact on the environment. According to Uher, (1999) and Shen *et al.*, (2000), these activities do significantly impact on the environment across a broad spectrum of, off site, on site and operational activities. The on- site construction activities relate to the construction of physical facilities, resulting in air pollution, water pollution, traffic problems and generation of construction waste

Throughout the world the impact of construction activities on the environment has been recognized. This in turn as led to a growing realization around the world on the need to alter or improve our conventional way of development into a more responsible approach which satisfies our needs for development without harming the world we live in, for sustainable development. Ofori *et al.*, (2000) noted that the construction industry has been challenged to seek to meet the growing human needs for shelter and facilities for production, services and leisure while conserving and protecting environmental quality and the natural resource base essential for future development. This challenge came in the form of publication of the ISO14000 series particularly the ISO 14001 Environmental Management Systems (EMS) in 1996. The ISO 14001 standard is well stated and in it organisations were given the responsibility to understand and implement it, to make the environment sustainable. However it is important to implement the ISO14000 series standards as environmental impact of construction process is known and widely discussed. And noted by Sanchez and Hacking (2002), the dissemination of ISO 14000 series of standards has paved the way for emergence of environmental management systems as a cost effective tool among others to improve eco-efficiency and boost company's public image. The Environmental Management Systems (EMS) was defined in ISO 14001 "as the part of the overall management system which includes the organizational structure, planning procedures, processes and resources for developing, implementing, achieving, reviewing and maintaining a company's environmental policy". This definition is seen by Ofori *et al.*, (2000) as a set of management tools, principles and procedures which an organization can use to help protect the environment from the potential impacts of its activities, products, and services. The ISO 14001 standard has a five-step cycle of commitment and policy; planning; implementation; measurement and evaluation; and review and improvement. According to Christini *et al.*, (2004), the ISO 14001 does not require any environmental performance metrics or absolute requirements other than: (1) committing to

comply with applicable legislation and regulations and (2) implementing a continual improvement process (ISO 1996).

CIRIA (1995) suggested that clients of construction industry should set up an environmental policy for their projects and to select consultants and contractors who can deliver on that. In many developing countries however and Nigeria in particular, site practices are not regulated and so environmental control are weak. This is however inimical to the environment. The problem is that even in regulated construction industries, contractors expected that environmental management would be a core requirement for the industry during the next century (Ofori *et al.*, 2002). Even to the extent that managers in the Singaporean construction industry felt the EMS cannot be implemented because of low level of awareness in the industry, shortage of qualified personnel, increased costs and changes in traditional practices. Similar challenges were also mentioned by construction managers in Hong Kong as impediment to EMS such as management costs, non-availability of trained staff to handle EMS; non-cooperation by sub-contractors, client not ready to support the process and the time needed to improve on traditional practices (Shen and Tam, 2002).

A review of research works show that some studies have been carried out on the environmental impact of construction activities (Cardoso, 2005; Ren *et al* 2012; Uher, 1999; Zolfagharian *et al*, 2012). Majority of these studies have identified the adverse environmental effects associated with building construction activities. These typically, include water and electricity consumption, ground movement, greenhouse gas emission, noise, waste and dust generation. However there is a dearth of research on the environmental management practices (EMP) employed and the factors that affect or determine environmental practice during construction process especially in the developing world. Studies like, Guggemos and Horvath, 2006; Ahn *et al.*, 2010, revealed that existing studies have concentrated on the environmental performance of buildings during their operational stage (life cycle phase). According to Yahaya and Abidin (2013), there has been many attempts in Malaysia to raise construction stakeholders' awareness and commitment to build with socially and ecologically responsibility. This was done through the Malaysians National Green Policy, the Green Technology Financial Scheme (SFTS) and Construction Industry Development Board (CIDB) Green Technology Programme. This is however not the case in Nigeria where the building control practices is yet to take off and no building regulations guiding the operations of contractors. However, in the study by Ojo *et al.*, (2015) it was concluded that in Nigeria the construction process impinge greatly on the environment. The question then is, are there not environmental management system by Nigerian contractors?. Hence, this study explores the environmental management practices (EMP) employed by construction firms in Nigeria and the factors that influence its practice on construction sites.

2. Literature Review

The construction industry is considered an important sector for development in any nation. It is a multifarious and multifaceted activity with two main classes of product – building: housing, offices, hospitals, factories etc, - Civil works: transport, irrigation, power generation etc. The industry contributes between 3 and 10% of the gross development product (GDP) in developing countries and records from the Federal Office of Statistics specifically ascertain that the contribution of construction industry to Nigeria's gross development product (GDP) has hovered around 2% for the past 15 years and this accounts for about 69% of the Nation's Gross Fixed Capital Formation (Wahab and Lawal, 2011).

The demand for constructed houses, commercial buildings and public infrastructure in the developing nations arise due to increase in urban population, economic and social development. However, little or no attention is given to the environmental impacts that arise from the construction processes, the unsustainable approach or manner to construction activities that have an adverse, direct and irreversible impact on the environment and people. (Yahaya and Abidin, 2013)

Studies conducted on environmental impact of construction activities include: Skanska (2010) on the energy and carbon dioxide emission during the construction process of a 13 storey office building project in the United Kingdom. The study revealed that 651 tons carbon dioxide was emitted, with 73% from electricity and 27% from fuel usage. Ochoa *et al* (2003) measured the carbon emitted from the process of constructing a two storey wood frame building in Pittsburgh; the study revealed that the construction of a typical residence could consume 550,000MJ of energy and produce 43tons of carbon dioxide of Green House Gas (GHG), 200kg of Nitrogen (NO₂), 300k g of Carbon (CO) and 100kg of particle pollution (PM). Similarly, Ren *et al* (2012) case study of a hotel project in South Wales revealed that construction activities generate more carbon than expected. The study found that materials delivery, operational activities and plant operations account for more than 90% of the total carbon emissions.

Chen *et al* (2004) concluded from their study in China that, sources of pollution and/ or hazard from construction activities could be categorized into seven major types, dusts, harmful gasses, noises, solid and liquid wastes, falling objects, and ground movement. Shen and Tam (2002) in their investigation of environmental management system in Hong Kong, classified environmental impact of construction as the extraction of

environmental resources, consumption of generic resources, production of waste that require the consumption of land for disposal and pollution of the environment with noise, odours, dust, vibrations, chemical and particulate emissions.

The studies of Li *et al* (2010) and Zolfagharian *et al* (2012) examined the environmental impacts associated with construction sites in China and Malaysia respectively. Their findings revealed that natural resource impact was the most severe impact, followed by ecosystem and public impact.

These studies reveal that there is need to urgently address the environmental impacts of construction site activities, which have negative effect on the environment. In order to minimize the impacts, there is need for the adoption of an environmental management system (practice) by construction companies. At present the major concern to construction firms is the management of cost, time and quality of projects which is beneficial to them while the management of the environmental impact of their activities is neglected. However, as acknowledged by Shen *et al.*,(2000) that knowing the potential detrimental effect and the dominant role of contractors in the construction process ,contractors' commitment in environmental practices is undeniably vital (Yahaya and Abidin, 2013).

3. Research Methodology

The scope of coverage of this research was confined to key construction industry participants in Lagos State, Nigeria. According to Aderogba,*et al.*, (2012) Lagos State with a land mass of less than 0.15 percent accounts for about 6 percent of the nation's population. It also serves as the main commercial nerve centre of the Nigeria economy activities, with the nation's major sea and airport cited therein. Lagos state was chosen for its high density infrastructural developments.

Primary data were obtained using questionnaire, interviews of site managers and site visits. Site managers responded to the questionnaire because according to CIRIA (2000) they are the key persons who are saddled with the responsibility of environmental monitoring rather than the individual at head office. The sites were selected from a numerical list of on-going construction projects (sites) in Lagos State that were identified. Systematic sampling techniques were adopted in the selection process based on the result of tossing of a coin. The selection commenced with the first number in the arithmetic progression of even numbers. This was the method used by Aibinu and Jagboro (2002) and according to Leedy (1980) it minimizes bias.

The questionnaire had introduction and two parts. The introduction gave a description of the survey, its purpose and objectives. The first part of the questionnaire solicited general information about the respondent profile (years of practice, educational level and professional affiliates). The second part of the questionnaire included a list of environmental management practices and the factors influencing environmental practice on construction sites. The respondents were asked to indicate on a Likert scale of 1-5, as 5- Always,4 - Mostly,3 - Sometimes, 2 - Seldom and 1 – Never, the environmental management they had used on site.

The data collected were analyzed with the use of descriptive and inferential statistical methods. The Mean Item Score (MIS) method was used to show the prevalent management practice and factors that affect its practice. The five-point scale 1-5 mentioned earlier was transformed to MIS for each of the environmental management practice and factors. The indices were then used to determine the rank of each item. According to Wahab and Lawal (2011), MIS is the ratio of the "summation of the weight value" (SWV) and the total number of respondents from all ratings. The nearer MIS to 5, the higher the level of prevalence of the categorized item. The SWV is the addition of the product of value attached to each rating and respective number of respondents. They are mathematically expressed as

$$SWV = \sum x_i y_i, \text{ and } MIS = SWV / \sum x_i$$

where;

$$X_i = \text{Number of respondents rating an item } i;$$

$$Y_i = \text{Weight assigned to item } i$$

4. Results and discussion

4.1 Respondents' Demographic Attributes

A total number of one hundred twenty questionnaires (120) were administered and seventy three (73) were retrieved representing a response rate of 61%. This was considered adequate for analysis based on the premise of Aibinu and Jagboro (2002), that the result of survey could be considered as biased and of little value if the return rate was lower than 30-40%. Summarized in table 1 are the attributes of the respondents in the study area. These include their profession, years of experience, type of firm and ownership structure. The table reveals that 14.00% (10) of the respondents were Architect, Builders 33.00% (24); Engineers 41.00% (30) and Quantity Surveyor 12% (9). This result clearly shows that the respondents were professionally qualified to supply the data necessary for the study. The table reveals that 42% (31) of the respondents possess 1 to 5years of experience while 26% (19) possess 6-10years; 14% (10) possess 11-15 years; 8% (6) possess 16-20 years; 10% (7) possess above 20years. This implies that they would have reasonable understanding of the research purpose. The table

also reveals that 21% (15) of the respondent were from large sized firm; 37% (27) from medium sized firm and 42% (31) from small sized firm. This result shows that the three categories of firms in the study area were considerably represented. The table reveals that 66% (48) of the respondents were from indigenous firm, while 34% (25) were from foreign firm.

Table 1. Demographic Attributes of Respondents.

Attribute	Frequency	Percent (%)
Profession		
Architect	10	14
Builder	24	33
Engineer	30	41
Quantity Surveyor	9	12
Years of experience		
1-5 Years	31	42
6-10 Years	19	26
11-15 Years	10	14
16-20 Years	6	8
Above 20 Years	7	10
Size of Firm		
Large	15	21
Medium	27	37
Small	31	42
Structure of Ownership		
Indigenous	48	66
Foreign	25	34

4.2 Environment Management Practices

Respondents were asked to indicate the environmental management practices they had used to mitigate the effect of their construction activities on the environment. The environmental management practices were derived from the requirements in ISO14001.

In Table 2 is the Mean Item Score (MIS) for the environmental management practices employed by construction firms on construction site in Lagos, Nigeria. It was decided that any item whose mean score falls below 2.50, be regarded as “not prevalent”, 2.50-2.99 as “slightly prevalent”, between 3.00-3.99 as “moderately prevalent” and 4.00-5.00 as “highly prevalent”. Based on this decision rule, “implementation of rewards/incentives” as environmental management practices was the only slightly prevalent and the least used by construction firms to mitigate the effect of its activities on the environment. The implication is that construction firms hardly reward their workforce for safeguarding the environment from destruction because most of them do not have policy in place to reward workforce to contribute to sustainable environment. However, the construction firms in Lagos, Nigeria use “poster and signs” as the most/ highly prevalent environmental management practice. On the site visited for this study “poster and signs” were commonly used to encourage the workforce to be environmentally friendly; warn visitors and the residents living within some radius about some hazardous site activities. In a study by Terio and Kohkonen (2011), the Finnish construction companies saw environmental poster and signs as beneficial in managing the construction activities against the environment.

Environmental inspection by management was rated the second most prevalent (MIS=4.12) means of managing the effects of construction process on the environment. What is mostly done here is that management at the head offices send delegation to the site to inspect construction procedures to ascertain whether methods are adhered to. For example, waste water properly channeled to prevent contamination of water resources, excavation done carefully to prevent dust pollution etc.

Planning and organizing the site (work environment) was rated third most prevalent (MIS of 4.04) method to prevent environmental pollution in construction. This involves the layout of site to minimize the regular need of vehicular movement (transportation) within the site; heavy equipment positioning; fencing etc. to prevent noise pollution, gas emission and intruders to the site.

Some of the environmental management practices that were rated moderately prevalent include, having environmental management plan for each site but 99% of the respondents’ companies do not have environmental policy. So the responsibility of managing the sites not to affect the environment is on the site manager. The site manager does this without any guideline by his company.

Others were, conducting environmental management meeting before each construction process begins; conducting regular site meeting with consultant to review environmental issues etc (see Table 2). Offsite fabrication and investment in personal protective equipment (PPE) were rated the least amongst those rated

“moderately prevalent” in that order. The implication is that in the Nigerian construction industry, most construction activities occur on the site and hence the danger of environmental effect is high. This is so because the construction activities are detrimental as they cause environmental pollution, solid wastes, resource depletion and loss of bio-diversity (Ofori *et al*, 2000). Also the Nigerian construction companies do not invest in their workforce protection. This is common with the medium and small sized construction companies; most companies in these categories have poor health and safety records.

What is worth nothing is the fact that, none of the respondent had used “environment performance assessment” to mitigate the effect of construction activities against the environment. This is however a requirement in ISO14000 standards. Some of the respondent interviewed believe since Environmental Impact Assessment (EIA) had been done by the client there was no need for them to assess their environmental performance since they follow standard construction activities. However, assessment of environmental performance can help the contractors set the standard/policy needed for environmental friendly activities (Tam *et al.*, 2004).

Table 2. Environment Management Practices

Environmental Management Practices	1	2	3	4	5	Sum	MIS	Rank
Displaying of posters	1	6	33	88	175	303	4.15	1
Environmental inspection by management (on each site)	1	8	39	108	145	301	4.12	2
Planning and organizing the site (layout)- work environment	1	12	39	88	155	295	4.04	3
Having a clear environmental management plan for each site	2	10	54	88	130	284	3.89	4
Conducting environmental management meetings before each major activities begin	3	20	24	152	70	269	3.68	5
Conducting of regular site meeting (environmental meetings) by site manager	7	18	21	112	110	268	3.67	6
Implementation of environmental fines	6	14	39	116	90	265	3.63	7
Implementation of disciplinary action	9	14	48	72	120	263	3.60	8
Conducting environmental impacts/management training and orientation for workers	5	6	63	128	60	262	3.59	9
Recording and reporting of daily environmental issues	7	10	54	100	90	261	3.57	10
Investment on new equipment that are more environmental friendly	6	20	27	80	127	260	3.56	11
Environmental inspection by government authorities	8	12	54	116	60	250	3.42	12
Off site fabrication	20	30	42	108	45	245	3.36	13
Investment in personal protective equipment (PPE)	9	6	87	92	45	239	3.27	14
Implementation of Rewards/ Incentives	9	26	99	52	25	211	2.89	15

4.3 Factors that influence environmental management practice on sites

In the Nigerian construction industry particularly in Lagos state it is mandatory that for a commercial project, an environmental impact assessment report be produced by the initiator of the project. It is expected that the contractor handling the project does everything possible to mitigate against any negative impact on the environment, if there are any. It is imperative therefore to understand what influence contractors in instituting an environmental management systems. Respondents were asked to rate factors influencing contractors in instituting environmental management practices on sites, using a five point Likert scale. The scale ranges from “1” meaning, “Not at all” to 5-meaning, “Greatly influenced”.

The decision rule was that any factor whose mean item score falls between 0.5 – 1.99 is regarded as “does not influence”; 2.00 – 2.99 as “slightly influenced”; 3.00 – 3.99 as “moderately influenced”; while 4.00 – 5.00 is regarded as “greatly influenced”.

The result in Table 3 revealed that, “type of project” with MIS of 4.36 was ranked first as the factor that greatly influenced the contractors in developing an environmental management system. This then means that, contractors in Lagos state of Nigeria will only think of environmental management system to mitigate the effect of construction on the environment if it is a commercial project as demanded by Lagos state government. Therefore the Nigerian government by legislation that EIA be prepared for all types of projects can increase the establishment of environmental management systems by Nigerian contractors.

Availability of a clear company environmental policy with MIS of 4.27 was rated second while management attitude towards environmental issues was rated third with MIS of 4.07. Nigerian construction site

managers agree that their management attitude and a clear company's environmental policy can encourage environmental management practice on construction sites. Christini *et al.*, (2004) believe without upper management support and decision to mandate a company-wide EMS, environmental personnel will not have resources to establish and maintain an ISO 14001 EMS. This is very important because almost all the sites managers indicated that their companies do not have environmental policy. Hence, a better attitude by management at head offices towards the effect of their activities on the environment and a clear environmental policy can greatly reduce the effect of construction activities on the environment. Contractors in the study carried out by Ofori *et al.*, (2000) indicated that they will seek ISO 14000 certification if the government makes it compulsory and if clients demand it. In Nigeria government (being the major client of the construction industry) do not demand environmental management systems by the contractors; hence their carefree attitude towards the environment.

Of the factors that moderately influenced contractors in having an environmental management systems; "workers environmental awareness, knowledge and involvement" was rated top. So if a site manager or other workers as a result of awareness of construction activities on the environment, campaign for its mitigation, contractors will establish environmental management system. Others that moderately influenced establishment of EMP included; size of project (square area); environmental awareness by top management; project location; ratio of site to building area; duration of project; method of construction, equipment used on site and planning and scheduling of project in that order. Except environmental awareness by top management staff, all others in this category are projects characteristics Hence projects based factors moderately influenced Nigerian contractors in their decision to establish EMP.

Of the factors that less influenced Nigerian contractors in developing EMS, number of workers on site was rated the least, followed by workers age (both factors have MIS of less than 2.0). This means, the age mix of workers and irrespective of their number on site do not matter to construction firms in terms of establishing EMP for a project.

Table 3. Factors that Influence environmental management practice on construction sites.

Factors	1	2	3	4	5	Sum	MIS	Rank
Type of project	1	4	30	68	215	318	4.36	1
Availability of a clear company environmental policy	1	8	21	92	190	312	4.27	2
Management attitude towards environmental issues	3	6	27	116	145	297	4.07	3
Workers environmental awareness, knowledge and involvement	3	12	51	112	95	273	3.74	4
Size of Project(square area)	6	12	69	52	125	264	3.62	5
Environmental awareness of company's top management staff	7	20	88	88	55	258	3.53	6
Location of project	13	10	21	148	60	252	3-45	7
Ratio of site to building area	0	32	84	80	45	241	3.30	8
Duration of project	8	24	60	104	35	231	3.16	9
Method of construction (mechanical or manual)	4	28	99	68	25	224	3.06	10
Equipment used on site	15	32	41	60	75	223	3.05	11
Planning and scheduling of the project	5	24	113	32	45	219	3.00	12
Cost of project	25	24	39	88	40	216	2.96	13
Weather condition	14	30	60	44	60	208	2.85	14
Application of new technology	13	24	72	84	15	208	2.85	14
Workers educational level	10	40	24	72	60	206	2.82	16
Building design and complexity	11	28	66	52	40	197	2.70	17
Type of owner/Client	20	18	78	48	30	194	2.66	18
Material choice	17	44	60	40	20	181	2.48	19
Increased job related pressure on workers	18	48	69	32	0	167	2.29	20
Workers experience	22	28	65	36	15	166	2.27	21
Relationship between the supervisor and site workers	15	64	60	24	0	163	2.23	22
Interrelationship between the workers on the site	18	64	48	24	5	159	2.18	23
Project cash flow	21	60	48	12	15	156	2.14	24
Workers age	43	26	18	40	5	132	1.81	25
Number of workers on site	27	38	51	9	0	124	1.70	26

5. Conclusion and Recommendation

This research work evaluated the environmental management practice and factors that influenced its adoption on

construction site in Lagos State, Nigeria. It was concluded from the study that, construction companies in Lagos State do not as a matter of policy have environmental practices to mitigate the effect of their activities of the environment. However, they mostly use the display of posters, inspection by management and planning and organizing site/work environment as EMP in their respective sites. The most prevalent factor that influenced the adoption of the EMP was, type of project, availability of a clear company policy on EMP and management attitude towards environmental issues. None of the respondents indicated that environmental performance assessment was a motivating factor to establish an environmental management practice. In order to mitigate the negative impact arising from construction sites in Lagos State, it was recommended that, construction companies should be mandated to have an environmental management policy, which should stipulate that for each construction site there must be an environmental management plan put in place before the commencement of construction activities.

6. Further Research

Based on the findings of this research, the authors would like to develop an environmental management systems for small and medium sized construction companies in Nigeria. This could reduce the impacts of the construction activities on the environment. Also a future research would be to develop a set of indicators for measuring environmental performance in Nigeria construction industry.

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