

## Analysis of Waste Encumbrances on Building Procurement in Southwest States of Nigeria

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**Abstract.** The study examines waste encumbrances on procurement of building projects in the southwest state of Nigeria. The study haphazardly sampled 261 practising professionals comprising of engineer, quantity surveyor, builder, architect, project manager, and planner in the study area. The data was collected through the use of a questionnaire. However, the result of the findings was analysed using the statistical package for social science (SPSS) application, and these were presented in tables. The results of the study found that; undefined in the scope of the project, waste management not design, choice of consultant, lack of early collaborative engagement, unclear brief/project definition, and timing rated 53.80%, 46.10%, 38.40% and 30.70% respectively were amidst the leading encumbrance on building procurement in the study area. The study also revealed that change in design, design and construction detail error, ambiguity and inconsistency in drawing, design error, variation/change order request, and last-minute were retest highest as among factors, and wrong choice of contractors', tender/contract document incomplete at the commencement of construction, and absence/poorly defined waste management responsibilities. Based on this, the selection process for buildings contractor, and workers should be selected based on experiences, measures that will ensure clarify of design, brief and construction bill should be in place. This will eliminate the present burden of material waste, price increase, project delay in term of time witness across different building projects in southwest Nigeria.

**Keywords:** Analysis, Encumbrance, Waste, Building Procurement, Southwest

### 1. Introduction

The global burden of building procurement waste is enormous and still growing specifically in Nigeria and many other developing countries in the light of the housing and infrastructure development component of the sustainable development goals (Tongo, 2020 & 2021). Wahab & Lawal, (2011) and Edoaka, et al., (2013) in their studies corroborated the earlier submission that the activities of building and infrastructure development have been on the rise as a result of the strong demand from the increasing population and urbanisation. This in turn has translated to a corresponding generation of an enormous amount of waste at the different stages of procuring building projects in the construction industry (that is; from the inception stage, through the design stage to the implementation stage and during the utilisation stage) amounting to between 30% - 35% of the industrial waste globally per annum translating to several billion tonnes globally (Solis-Guzman, et al., 2009).

This includes those wastes produced from the activities of maintenance/renovation of the buildings and demolition at the end of life. Olusanjo, Panos, & Ezekiel, (2014) citing sir Egan's rethinking construction reported that close to 30% of all construction work are made up of works that are being re-executed. It also said that about 50% of labour is lost to inefficiencies and that only about 90% of the building materials purchased for a project are effectively used, the remaining 10% wasted. The waste generated from building and construction projects is huge and accounts for a sizeable proportion of the overall amount produced in many

countries, making it the single largest waste stream (Bates, 2006).

Recent studies from developing countries like Nigeria show that it is a popular practice for a large portion of building wastes to be illegally dumped by roadsides, river banks and stockpiled in many other open spaces where some of them are either burnt or buried on the same site (Mahayuddin, et al., 2008). It was reported that, if these illegal dumping of building and construction debris are not checked, it has the propensity to affect the well-being of people, the value of properties, and the cost of cleaning up the mess. Likewise, incineration of wastes leads to the generation of a large volume of nitrogen oxide gases that can potentially contribute to the existing environmental issues such as acidification and ecotoxicity, with the volume of residual ashes attaining a very high level with toxic substances (Qian, Cao, Chui, & Tay, 2006), while Tan & Khoo, (2006) claimed that the energy gained from the process outweighed the environmental damage.

The inappropriately managed waste has the potential to cause traffic obstruction, block storm drains and other waterways such that; flooding, unpleasant visual perception and general environmental degradation which impacts the health and safety of the workers, as well as the socio-economic aspects of the society. Ordinarily, stockpiling of rubbles from construction works was considered useful as it could be used in earth filling/land reclamation projects on a later day (Poon, Yu, & Ng, 2001). This was thought to be an efficient way of reusing inert materials but, there aren't enough such projects to total absorb the stockpiled wastes. It has therefore become increasingly difficult and uneconomic to sort inert materials for use by other projects as filling materials (Einstein Network, 2002).

Also, a large portion of these wastes are buried or ends up in landfills mostly in the industrialised nations due to their non-combustible nature; in the UK, about 89.6 million tonnes of waste were generated from construction-related activities in 2005 out of which about 31% (that is, 28 million tonnes) went to the landfill. In Australia (between the years 2006 and 2007), about 7 million tonnes of waste was sent to the landfill (Olusanjo, et al., 2014). Like in many other recent studies, Yu, Poon, Wong, Yip & Jaillon (2013) reported that the existing landfills in Hong Kong can no longer cope with the volume of waste disposed of in them daily while Hostovsky, (2004) observed that in recent time, landfills could no longer provide the desired long term and sustainable solution to manage waste; hence they have become a

headache to many cities. Finding new sites suitable for landfill activities has always been a tough task because they require large pieces of land, which have to fit well with the geological and engineering criteria (Hostovsky, 2004). Depountis, Koukis, & Sabatakakis, (2009) informed that more waste is presently being generated per capita and this has contributed to shortening the lifespan of many landfills significantly.

The absence of which has given rise to increased environmental problems like noise pollutions, emissions of dust and gases to the atmosphere and contaminated water to watercourses. And, extending the existing sites is extremely costly (Yu, 2010). This land-use conflict was brought about by the Not-In-My-Backyard syndrome and the more demanding administrative procedure imposed by the environmental impact assessment policies make the siting of new waste facilities a time-consuming herculean task (Hostovsky, 2004) in many countries. Studies found that material waste significantly attracts additional cost to the estimated cost of building projects as a result of the new purchases that have to be made to replace the wasted ones; the cost of demolition and executing previous unsatisfactory works; time losses due to delays and the cost of disposing of the waste.

They all add up to the financial losses by the contractor (Ekanayake & Ofori, 2000). Hence, construction waste reduction is currently being accorded the highest priority amongst waste management options today which includes; reduction, recycling and reuse. Despite knowing the problems associated with building procurement waste generation, very large amounts of wastes that can be recycled and/or has high reuse value are generated and disposed of indiscriminately or used in low-value applications (Waste Management World, 2007 and Einstein Network, 2002). It has also been reported that many of the industry practitioners in various countries are still struggling to grapple with the act of reducing and recovering waste from procurement activities due to the huge financial outlay required to manage them.

The attitude of the industry stakeholders towards managing building waste is a result of the lack of knowledge/awareness, the government's willingness to implement waste reduction policies and the inadequacies of the existing recycling capacity (Waste Management World, 2007 and Einstein Network, 2002). The failure of the efforts of various nations to effectively manage building waste and treat the environment adequately has resulted in

many serious social, economic and environmental issues. The resultant pollution constitutes a huge financial burden to the current and future generations in many of our cities in the form of natural resource consumption and depletion, loss of soil, loss of agricultural land, biodiversity loss, atmospheric emission, and environmental degradation of the land, air and water resources, as well as rapid deforestation. Bentivegna, Curwell, Deakin, Lombardi, Mitchell & Nijkamp, (2002) stated that if this trend is not checked, there is a possibility that it could lead to desertification and other adverse ecological consequences.

All these will in turn constitute a threat to the achievement of the overall objectives of sustainable development goals (SDGs) (Yang & Shi, 2000). The landfills which were considered as the most widely used method to dispose of municipal solid waste and building wastes have recently become too expensive and unsustainable for our environment. The landfills are filling up faster than can be imagined making them programmed shut down imminent very shortly; therefore, it is of essence that we must find an alternative of dealing with building and construction wastes. This includes source reduction of waste generation, reusing of some of the previously used materials and recycling to reduce the quantities and risks therein and to create a future we would want to live in.

The problem of waste management has become a matter of political discussion at the international level especially now that the ability to secure suitable spaces to treat locally generated waste in some societies has become near impossible in some society. Bai & Sutanto, (2002) based on their experiences in Singapore, submitted that the cost of recycling has become too much higher than originally anticipated because of the prevailing high cost of collecting, transporting and handling wastes.

However, the practices of shipping waste across international borders which hitherto was seen by some practitioners as a cheaper alternative to landfilling especially in countries with limited landmass and strong advocacy groups have since become a condemnable act with prohibition by many international treaties such as the Basel Convention (Hostovsky, 2004; Mak, 2008).

**2. Research Materials and Methodology**

In order to collect data and to achieve the aim of this study, a total of four hundred and three (403) questionnaires were randomly administered to a study population made up of practising consultant architects, consultant engineers and consultant quantity surveyors working in ARCON, COREN and QSRBN registered firms across the six (6) states (, Ekiti State, Lagos State, Ogun State, Ondo State, Oyo State and Osun State) that make-up the Southwest of Nigeria to analysis waste encumbrance on building procurement in the study area.

**3. Findings and discussions**

The results of the finding presented in table 3.1 on the causes, sources and contributing factors of building procurement waste on pre-design factors that cause waste in building construction. From this, the study confirmed that last-minute client requirement, choice of procurement method, constraint rating and no specific waste minimization directives given are the highest as factors/ causes of building procurement waste according to the degree of their contribution at the pre-design stage. Next to this are undefined project scope, waste management not design, choice of consultant, lack of early collaborative engagement, unclear brief/project definition, timing rated 53.80%, 46.10%, 38.40% 30.70% respectively.

**Table 3.1:** Respondents’ Perception Causes of Factors of Waste (Pre-Construction)

Cause Factors of Waste Pre-Construction	Mean	Rank	Percent	Grade
Wrong Choice of Contractor's Tender/Contract Document Incomplete at Commencement of Construction	3.25	1	100.00%	A
Absence/Poorly Defined Waste Management Responsibilities'	3.01	2	90.00%	
No Financial Costing of Waste in the BOQ	2.98	3	80.00%	
Incomplete Information from the Design Team	2.97	4	70.00%	
No Target Setting and Implementations Guide	2.96	5	60.00%	B
Incoherent Information Release	2.93	6	50.00%	C
Lack of Waste Management Design Intent	2.9	7	40.00%	D
Error in Contract Document	2.85	8	30.00%	E
Other Pre-Construction Activities	2.69	9	20.00%	
Incomplete Tender Document	2.55	10	10.00%	
	1.1	11	0.00%	

However, lack of contractor early involvement, client-driven rating and other pre-design are among the factors that cause and contributes to building procurement waste according to the degree at the pre-design stage.

The study in table 3.2 shows findings on respondents’ perception of the causes, sources and contributing factors of building procurement waste on the design stage in building construction. The study confirmed that among the factors complicated and complex design rate, design and construction detail error, ambiguity and inconsistency in drawing, design error, variation/change order request, and last-minute were retest highest as (grade A) among factors that cause waste in procurement building construction having mean of 3.32, 3.23, 3.22, 3.21, 3.17, 3.11 respectively, some factor is also rated grade ‘B’.

**Table 3.2:** Respondents’ Perception Causes of Factors of Waste (Design Activities)

Cause Factors of Waste (Design)	Mean	Rank	Percent	Grade
Complicated and Complex Design Rating	3.32	1	100.00%	A
Design and Construction Detail Error	3.23	2	96.10%	
Ambiguity and Inconsistency in Drawing Rating	3.22	3	92.30%	
Design Error Rating	3.21	4	88.40%	
Variation / Change Order Request Rating	3.17	5	84.60%	
Last Minute Client Requirement Rating	3.11	6	80.70%	
Frequent Design Changes Rating	3.1	7	69.20%	B
Inexperienced Designer Rating	3.1	7	69.20%	
Lack of full Design Team Coordination Rating	3.1	7	69.20%	
Poor Coordination and Communication between Various Specialist Rating	3.09	10	65.30%	C
Inconsistencies of Detailing Error Rating	3.06	11	61.50%	
Lack of Clear Design Information Rating	3.05	12	53.80%	
Unclear Incoherence Specification Rating	3.05	12	53.80%	
Poor Design Quality Rating	2.99	14	46.10%	
Error in Contract Documentation Rating	2.99	14	46.10%	D
Different Site Conditions Rating	2.95	16	42.30%	
Incomplete Contract Documentation Rating	2.91	17	38.40%	
Time Constraint of Incoherence specification Rating	2.9	18	34.60%	
Slow Response to Request for Information Rating	2.89	19	30.70%	E
Time Constraint Leading to the Use of off-the Shelf Detail Rating Procurement Waste	2.88	20	26.90%	
Lack of Partnering Commitment and Coordination among Consultants Rating	2.8	21	23.00%	
Inconsistence Complex Detail Rating	2.77	22	19.20%	
Slow Drawing Revision and Distribution Rating	2.72	23	15.30%	
Designers Reluctant to Prefabricated Component Rating	2.67	24	7.60%	
Over Specification Rating	2.67	24	7.60%	
Limited Use of off-site Construction Techniques Rating	2.59	26	3.80%	
Other Design Rating	0.81	27	0.00%	

This includes factor-like frequent design change, inexperienced design, inconsistencies in detailing error etc. were responsible for wastage in the design having a relative mean of 3.1, 3.1, 3.1, 3.09, 3.06 respectively, followed by factors such as lack of clear design information, unclear incoherence specification, poor design quality, error in contract documentation had a relative mean of 3.05, 2.99 and 2.95 respective, also some factor such as incomplete contract documentation rating, time constraint of incoherence specification, slow response to a request for information, time constraint leading to the use of the off-the-shelf and lack of partnering commitment and coordination among consultants was graded ‘D’ had mean of 2.91, 2.90, 2.89, 2.88 and 2.80 respectively. Last on the list are the factors graded ‘E’ those factors according to the study in table 3.2, had the least effects, those factors include inconsistence complex detail rating, slow drawing revision and distribution, designers reluctant to a prefabricated component, over-specification rating, limited use of off-site construction techniques, and other design ratings also, had mean of 2.77, 2.72, 2.69, 2.59 and 0.81 respectively.

**Table 3.3:** Respondents’ Perception Causes of Factors of Waste (Pre-Construction)

Cause Factors of Waste Pre-Construction	Mean	Rank	Percent	Grade
Wrong Choice of Contractor's Tender/Contract Document Incomplete at Commencement of Construction	3.25	1	100.00%	A
Absence/Poorly Defined Waste Management Responsibilities'	3.01	2	90.00%	
No Financial Costing of Waste in the BOQ	2.98	3	80.00%	
Incomplete Information from the Design Team	2.97	4	70.00%	
No Target Setting and Implementations Guide	2.96	5	60.00%	B
Incoherent Information Release	2.93	6	50.00%	C
	2.9	7	40.00%	D

Lack of Waste Management Design Intent	2.85	8	30.00%	E
Error in Contract Document	2.69	9	20.00%	
Other Pre-Construction Activities	2.55	10	10.00%	
Incomplete Tender Document	1.1	11	0.00%	

The study in table 3.3, shows findings on respondents' perception of the cause of factors of waste on building procurement waste during the pre-construction stage. The ranking was grade from A-E, based on the mean of each factor, from this wrong choice of contractors', tender/contract document incomplete at the commencement of construction, absence/poorly defined waste management responsibilities and no financial costing of waste in the BOQ fallow under grade "A" with mean of 3.25, 3.01, 2.98 and 2.97 respectively, factor on grade "B" include incomplete information from the design team, grade "C" factor consist of no target setting and implementations guide. Grade "D" take account of factor like incoherent information release with mean of 2.9. The least on the ranking includes lack of waste management design intent, error in the contract document, other pre-construction activities and incomplete tender document having mean of 2.85, 2.69, 2.55 and 1.1 respectively.

#### 4. Conclusion Recommendations

Based on the result of the finding of this study, the following activities are needed:

- Practitioners should partner with the government in the provision of the needed,
- Government should provide infrastructure to encourage motivation to manage material waste from building projects,
- The building construction industry professionals and policymakers should work hand-in-hand for the management of wastes on every building project site,
- Government should regulate the material waste generation and management on building construction projects through policies, and
- All the professional bodies in the built sector should organize membership mandatory development training and re-training program from time to time to keep the member well-informed of current technology and changes.

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