KIU Journal of Social Sciences Copyright©2021
Kampala International University ISSN: *2413-9580*; 7(2): 265–273

A Prospective Study of Wastes from Design Stage Activities on Building Construction Projects in Southwest Nigeria

SAMUEL O. TONGO, A.A. DIPEOLU, C. ALAKA
Olabisi Onabanjo University, Ibogun Campus, Ogun State, Nigeria

J.O. OBALEYE
Caleb University, Imota, Lagos State, Nigeria

Abstract. This study examines the factors that contribute to the generation of wastes from design stage activities in building construction projects in the southwest region of Nigeria. A total of 261 questionnaires were randomly administered to representatives of firms in the built environment professions across the six (6) states that make up the region. The data generated were analysed using excel-solver and SPSS, and the findings were presented using tables. The study found that 86.97% of the respondents were experienced professionals with cognate experience who are employed by professionally registered consulting firms while the remaining 13.03% of the respondents were jointly employed by contracting firms, and some client agencies operating in the study area. The result of findings further showed that 70.345% of the main issues related to waste generation from design stage of building projects were due to ambiguities and inconsistencies in drawings; inexperienced designers; lack of clear design information at conception; design and construction detail errors; design errors; unclear and incoherent specifications; poor communication between the various specialists and lack of full design team coordination. Besides this, the result also showed that the 43.862% of the residents listed inadequate coordination due to the high loadings by the following items: incomplete contract documentation; last-minute client requirement; error in contract documentation; slow response to a request for information; slow drawing revision and distribution; lack of partnering commitment and coordination among consultants; variation/change order request. This study therefore recommends that policy thrust should be aimed at encouraging built environment professionals to take actions towards reducing wastages in project at the design stages of building construction processes and activities in the study area.

Keywords: Building Construction, Construction, Southwest States, Waste Management, Prospective

1. Introduction

Wastage of materials remains one of the major problems in the building and construction industry anywhere in the world (Tongo, Oluwatayo & Adeoye, 2021; Aniekwu, Anthony & Onifade, 2015). The building and construction industry generates more material waste than the household sector and it accounts for more than 50% of the deposited material in a typical landfill globally. The studies by Ruiz, Ramón and Domingo (2020); Chowdhury, Upadhyay, Briggs and Belal (2016), and Osmani (2011) all agreed that building construction waste has become the single largest waste stream in the world in quantitative terms and comparison, to other waste streams.

Waste in building construction means so many things to different people. Its definition has been addressed by different building construction industry professionals and academia. Zheng, Wu, Zhang & Song, 2017 defined wastes from building and construction-related activities as being made up of a wide variety of both inert and organic materials emanating from the activities of construction. Such materials include rubble, earth, concrete, steel, timber and all other site clearance materials generated during construction activities. Akhtar and Sarmah (2018) described these wastes as consisting of sizable units of debris in large volumes which are solid in nature. Some researchers (Chooi, Takeshi & Chin, 2018 and Bekr, 2014) conceptualised waste as any production inefficiency that emerges from the use of equipment, materials, and labour or capital. While in another study (Nagapan, Abdul, Ismail, Asmi, Ade, . . . Rosli, 2012), waste is categorised into two types; physical that is, direct/material waste or debris arising from building construction activities and non-physical that is, indirect wastes such as time overruns and cost overruns.

Kofoworola and Gheewala (2009); Wahab and Lawal (2011) in researches from Thailand, Nigeria, Malaysia, and Indonesia described building wastes as not only associated with the material waste from construction processes alone, but includes wastes from other activities in the development of a building project. Such as delays resulting from time spent on the repairs of broken-down equipment and machinery, materials stored far away from the point where they are needed, poor and inadequate handling of material and damages during on-site transportation, which is both physical and non-physical; are generated both directly and indirectly. Both categories of waste result from human errors during the project preparatory and design stages, delays to the work and the wrong use of; equipment, materials, labour, and capital, as they are generated across the life cycle stages of building projects (Oyenuga & Bhamidiarri, 2015; Wahab & Lawal, 2011).

Building construction waste can be separated into three major categories: material, labour and machinery waste (Ekanayake & Ofori, 2000). Material waste however is of greater concern as it is extremely expensive and is made up of non-renewable resources. According to H Lau (2008), large amounts of material wastes are generated from construction sites. Great amounts of costs on construction projects are directly increased through the wastage of material, labour and machine time. Several scholars in recent studies, (Tongo et al, 2020; 2021; Ginga, Ongpeng & Daly, 2020; Polat, Damcı, Türkoğlu & Gürgün, 2017; Saidu & Shakantu 2016; Zheng et al. 2017; Adewuyi & Otali, 2013) mentioned the adverse effects of building waste and the implications that it portends for the efficiency of the building construction industry. Similarly, Saidu, Shakantu, Adamu and Anugwo (2017) and Ameh and Itodo (2013) in their studies corroborated the earlier position that material waste generation in building construction projects translates to cost overruns and unfortunately, not much attention has been given to its effects on the efficiency of the industry and the environment.

The study conducted by Fangama and Hamed (2018), in Sudan, recognized that the accumulation of construction waste has a grave effect on the landscape which in turn leads to visual pollution, unpleasant odour, and unattractive appearance of piles of uncollected solid waste along streets and on water bodies. While, Ferronato & Torretta, 2019 citing Sanneh, Hu, Chang & Sanyang, commented on the unpleasant visual effects that building waste has become in the community. On the other hand, Ferronato & Torretta, 2019 citing Sanneh et al, reported that increasing generation of building waste has significant effect on safety and decreasing property values in the affected communities especially in developing countries like Nigeria.

Silva et al., 2017; Saadi et al., 2016; Saidu & Shakantu 2016 reported that the increasing volume of building waste has become unbearable for the environment leading to pollution/degradation, while Othman et al., 2018; Aini & Shazwan, 2017; Shaoli & Biswajit, 2016; Saadi et al., 2016 made submissions on the public health concerns for the society. Another study by Ferronato & Torretta, 2019; Mah, Fujiwara and Ho (2018); Thomas and Costa, (2017), concluded that if this trend is not checked, there will be the possibility that the building waste crisis could lead to adverse ecological consequences, which could, in turn, become a threat to the realisation of the overall objectives of sustainable development goals (SDGs) as pointed out by Oyenuga and Bhamidiarri (2015).

This study, therefore, sought to bridge the gap in knowledge on building waste generation in Nigeria by examining the factors that contribute to the generation of wastes the design stages of building projects in the study area. It is therefore hoped that this study will build on the available but limited knowledge to generate information that will be vital to the formulation of effective waste minimisation strategies and policy in the Nigerian building industry.

2. Study Area

The problem of waste from building construction and other developmental activities has attained an international status hence, the paper in this area is of relevance to the built environment industry in any part of the world. However, the scope for this study has been delimited by the geographical border that defines Southwest States of Nigeria (that is, the study area), which is one of the geographical regions in Nigeria consisting of Ekiti, Lagos, Ogun, Ondo, Osun, and the Oyo States with focus on the capital cities of Ado Ekiti, Ikeja, Abeokuta, Akure, Oshogbo and Ibadan. The choice of Southwest Nigeria is predicated on the fact that from literature, the Southwest area of Nigeria has the second largest (38,259,260 persons) population per region after the Northwest region of Nigeria with 44,942,337 (United Nations Department of Economic and Social Affairs (UN DESA), (2019)), and other available data showing that, with Lagos, the region has the fastest-growing urban population in Nigeria with all the attendant demand for housing and infrastructure that is associated with urbanisation, and this provide a good reason for choosing the region for this study.

3. Materials and Methods of Analysis

This study was conducted using a structured questionnaire and a field survey for investigating the industry professionals' perception of the main issues related to waste generation from the design stage activities of building construction projects in Nigeria. Copies of the questionnaire were randomly administered to registered firm of architects, engineers, quantity surveyor, project manager, who are the primary consultants involved with building construction procurement as well as some client agencies and building contractors across the six (6) state in the southwest region of Nigeria. In all, two hundred and sixty-one (261) registered firms with ongoing projects in the study area. These firms were explored using the questionnaire survey to extract information about their knowledge and attitudes regarding building wastes and its generation from building construction processes.

4. Results and Discussions

The data for this study were obtained from the copies of questionnaires that were properly filled out and returned. From Table 1, it is seen that a total of two hundred and sixty-one (261) out of the four hundred and three (403) copies of the administered questionnaires were returned giving a response rate of 64.76%.

Table 1: Analysis of Respondents Response

	No administered	No retrieved	Response rate (%)
Architect	135	111	
Engineer	107	46	
Quantity Surveyor	161	70	
Contractor	20	23	
Client Agency	10	11	
Total	**403**	**261**	**64.76**

From Table 2, it is seen that most (84.3%) of the respondents were males, while the remaining 15.7% of the respondents were females. A little over half (59.4%) of the population were between 31 and 45 years old, followed by those between 46-60 years (33.3%) and those below 30 years (4.6%). Many (41.0%) of the industry practitioners surveyed belonged to the architecture profession, followed by those in the quantity surveying profession (38.3%) and the civil/structural engineering profession (19.9%). The remaining 0.8% of the respondents belonged to the building profession, though not listed but were representatives of both the contracting firms and/or the client agencies. Majority (61.3%) of the respondents had attained the Master of Science/Technology (MSc/MTech) degrees status, while 23.3% had attained the Bachelor of Science/Technology (BSc/BTech) degrees status and 10.0% the Higher National Diploma (HND) status in their respective disciplines. The remaining 5.4% filled for other educational qualifications which included the Doctor of Philosophy (PhD), Postgraduate Diploma/Certificate in Management Science, Architecture, Engineering, Quantity Surveying, and Building, as well as the National Diploma status in the respective professions applicable in the built environment. Also, majority (98.9%) of the respondents were corporate and affiliate members of their respective professional bodies which included (MNIA-41%, MNIQS- 37.2%, and MNSE- 20.7%). The other professional affiliations not specified in the questionnaires administered but were listed by the respondents were the Nigerian Institute of Builders (MNIOB), Nigerian Institute of Town Planners (MNITP) and Nigerian Institution of Surveyors (MNIS); which together make up the remaining (1.1%) of the surveyed population. Two respondents who academically qualified as builders were professionally registered as members of the Nigerian Society of Engineers (MNSE).

Table 2: Respondents' Demographics

		Frequency	Percent %
Sex	Male	220	84.3
	Female	41	15.7
	Total	**261**	**100**
Age	Less than 30	12	4.6
	31 - 45 Years	155	59.4
	46 - 60 Years	87	33.3
	Above 60 Years	7	2.7
	Total	**261**	**100**
Respondents' Nationality	Nigerians	260	99.6
	Non-Nigerians	1	0.4
	Total	**261**	**100**
Profession	Architect	107	41.0
	Engineer	52	19.9
	Quantity Surveyor	100	38.3
	Others (Builders and Surveyors)	2	0.8
	Total	**261**	**100**
Level of Education of the Respondent	HND	26	10.0
	BSc/BTech	61	23.3
	MSc/MTech	160	61.3
	Others (PhD, PGD, etc.)	14	5.4
	Total	**261**	**100**
Professional Qualification	MNIQS	97	37.2
	MNSE	54	20.7
	MNIA	107	41
	Others (MNIOB, MNITP, and MNIS)	3	1.1
	Total	**261**	**100**

The findings from the analysis of the respondents' demographic data showed that the population of the female construction industry workers are much lower than the male counterparts. This result is similar to the National Bureau of Statistics (2015) report. A further review indicated that this may affect the overall industry position on the adoption of building procurement waste management practices hence, more women should be encouraged to join the industry. In a similar manner, analysis of the nationality distribution of the respondents indicated that the sampled population is primarily Nigerian and like the study by Ryal-Net and Kaduma (2015), the findings from this study will be adequate and satisfactory enough to conclude with, since the respondents who gave the needed information are those who are aware of their environment and are qualified through training and experience.

Table 3, revealed that majority (42.5%) of the respondents indicated that their firms are registered with the Architects Registration Council of Nigeria (ARCON). About 17.6% of the respondents indicated that their firms are registered with the Council for the Regulation of Engineering in Nigeria (COREN), while 26.8% of the respondents sampled worked with firms that are registered with Quantity Surveyors Registration Board of Nigeria (QSRBN). Table 3, also show that 13.0% of the respondents were engaged by contracting firms, client agencies, and some other firms who are registered with other professional organisations which were not listed by the study, for example, Council of Registered Builders of Nigeria (CORBON), Town Planners Registration Council (TOPREC), and Surveyors Registration Council (SURCON).

Table 3: Analysis of Firm Registration by Professional regulatory bodies

Registration with Professional regulatory body	**Frequency N**	**Valid Percentage (%)**
ARCON/Consulting	111	42.5
COREN/Consulting	46	17.6
QSRBN/Consulting	70	26.8
Others (Contractors, Client Agencies and others who are registered with CORBON, COREN/M&E Engineers, SURCON and TOPREC)	34	13.0
Total	**261**	**100**

Table 4, shows that respondents' perception of the causes of waste emanating from design stage activities in building and construction projects. The findings showed that there are twenty-seven (27) factors affecting waste generation from the design stage activities of building construction projects in the study area. Among these factors are: complicated and complex design rate, design and construction detail error, ambiguity and inconsistency in drawing, and design errors ratings with corresponding mean item scores of 3.32, 3.23, 3.22, and 3.21 respectively. Their reported high values show that they have significant effect on waste generation from design stage activities. It is also seen from Table 4 that the other design factor rating has the least effect on waste generation from design stage activities with a mean item score of 0.81.

Table 4: Respondents' Perception of Factors Relating to the Generation of Waste from Design Stage Activities in Building Projects

Cause Factors of Waste from Design Stage of Building Projects	**Mean Item Score**	**Rank**	**Percent %**
Complicated and Complex Design Rating	3.32	1	100.00%
Design and Construction Detail Error Rating	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%
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%
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%
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%
Time Constraint Leading to the Use of off-the Shelf Detail Rating Procurement Waste Rating	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	2.69	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%

Similarly, Table 5 show the result from the factor analysis carried out on the twenty-seven (27) variables established from the study to affect waste generation from the design stage activities of building projects with their varimax rotation. The analysis yielded six (6) extracted factors which altogether accounted for a total of 70.345% of the variance for the entire set of variables. Factor 1 was labelled "**inexact design process"** due to the high loadings by the following items: ambiguity and inconsistency in drawing; inexperienced designer; lack of clear design information; design and construction detail error; design error; unclear incoherent specifications; poor communication between various specialist and lack of full design team coordination. This first factor explained 43.862% of the variance in the data. The second factor derived was labelled "**inadequate coordination"** due to the high loadings by the following items: incomplete contract documentation; last-minute client requirement; error in contract documentation; slow response to a request for information; slow drawing revision and distribution;

lack of partnering commitment and coordination among consultants; variation/change order request. The variance explained by this factor is 7.858%.

The third factor derived was labelled "**inconsistent design conditions"** due to the high loadings by the following items: different site conditions; inconsistent and complex details; inconsistencies of detailing error; time constraint of incoherence specification. The variance explained by this factor is 5.953%. The fourth factor derived was labelled "**lack of design cohesion"** due to the high loadings by the following items: poor design quality; complicated and complex design; over-specification; frequent design changes; time constraint of incoherence specification.

The fifth factor derived was labelled "**limited use of modern construction techniques"** due to the high loadings by the following items: designers' reluctance to use off-site construction techniques; designers reluctant to use prefabricated components. The variance explained by this factor is 4.079%. The sixth factor derived was labelled "**other design factors"** due to the high loadings by the following items: other design factors. These include poor waste management strategies at the design stage and over allowance by the engineers in the safety factors used in the designs and over allowance by the quantity surveyors in the preparation of the Bill of Quantities (BoQ). The variance explained by this factor is 4.008%.

The commonalities, which can be regarded as indicators of the importance of the variables in the analysis are generally high (above 50%) across all datasets hence, the variables selected for this study are appropriate and relevant. The relative importance of the factors affecting waste generation from design stage activities of the building construction process is shown by their Eigenvalues, which indicated that the time constraint variable is the most important factor that affects waste generation from design stage activities.

Table 5: Rotated Factor Matrix of Factors Affecting Waste Generation from Design Stage Activities Rotated Component Matrix

Factors / % Variance Rotation Sums of Squared Loadings	**Variables**	Component						
		Factor 1	**Factor 2**	**Factor 3**	**Factor 4**	**Factor 5**	**Factor 6**	**Communalities**
Factor 1: Inexact Design Process (22.964%)	Ambiguity and Inconsistency in Drawing	**.835**	.126	.180	.118	.114	-.068	0.778
	Inexperienced Designer	**.799**	.207	.211	.231	.056	.036	0.785
	Lack of Clear Design Information	**.767**	.262	.231	.276	.042	-.130	0.805
	Design and Construction Detail Error	**.766**	.175	.293	.041	.155	.085	0.736
	Design Error	**.756**	.209	-.003	.273	.090	-.064	0.702
	Unclear/Incoherent Specifications	**.701**	.227	.334	.158	.189	.206	0.757
	Poor Coordination and Communication between Various Specialist	**.647**	.493	.365	.048	-.007	-.057	0.800
	Lack of full Design Team Coordination	**.642**	.503	.277	.013	.085	.013	0.750
Factor 2: Inadequate Coordination (16.593%)	Incomplete Contract Documentation	.151	**.786**	.021	.321	.151	.077	0.773
	Last-Minute Client Requirement	.158	**.744**	.268	.221	.079	-.115	0.720
	Error in Contract Documentation	.429	**.732**	-.022	.112	.183	.089	0.774
	Slow Response to Request for Information	.234	**.725**	.145	.053	.022	.212	0.650
	Slow Drawing Revision and Distribution	.404	**.490**	.388	.065	.187	.298	0.681
	Lack of Partnering Commitment and Coordination among Consultants	.094	**.488**	.419	.302	.328	.178	0.652
	Variation / Change Order Request	.434	**.461**	.348	.020	.160	-.262	0.617
Factor 3: Inconsistent Design Conditions (11.051%)	Different Site Conditions	.351	.148	**.744**	-.093	.086	.003	0.715
	Inconsistence Complex Detail	.176	.188	**.739**	.219	.093	-.086	0.676
	Inconsistencies of Detailing Error	.498	.100	**.608**	.150	-.061	.065	0.658
	Time Constraint Leading to the Use of off-the Shelf Detail	.284	-.022	**.502**	.391	.166	.293	0.600
Factor 4: Lack of Design Cohesion (8.496%)	Poor Design Quality	.536	.182	.192	**.627**	.013	.047	0.753
	Complicated and Complex Design	.148	.357	.149	**.600**	.101	-.299	0.631
	Over Specification	.166	.445	.164	**.537**	.259	.145	0.629
	Frequent Design Changes	.330	.473	-.067	**.534**	-.082	-.167	0.657
	Time Constraint of Incoherence specification	.425	-.015	.261	**.431**	.305	.426	0.709
Factor 5: Limited Use of Modern Construction Techniques (6.398%)	Designers' reluctance to use off-site Construction Techniques	.102	.037	.157	.174	**.833**	.068	0.765
	Designers Reluctant to Prefabricated Component	.161	.370	-.008	-.052	**.696**	-.145	0.671
Factor 6: Other design factors	Other Design factors	-.066	.136	-.005	-.074	-.043	**.722**	0.551
	Eigen Initial Values	11.843	2.122	1.607	1.238	1.101	1.082	
	% Of Variance	43.862	7.858	5.953	4.585	4.079	4.008	
	Cumulative %	43.862	51.720	57.673	62.258	66.337	70.345	

Extraction Method: Principal Component Analysis.
Rotation Method: Varimax with Kaiser Normalization.
Rotation converged in 20 iterations.

The result (Table 4) confirmed that the factors associated with waste generation from design stage activities in building projects are varied and dependent on several (27) factors based on their mean item scores and Table 5 presented the cause factors under six (6) different groups (that is: inexact design process group, inadequate coordination group, inconsistent design conditions group, lack of design cohesion group, limited use of modern technology group and the other factors) that were adopted for the study.

A further review of the results (Table 4) showed that complicated and complex design rate, design and construction detail error, ambiguity and inconsistency in drawing, and design errors are those factors with the highest mean item scores, hence they are seen to have the highest influence on waste generation by design stage activities. While Table 5, showed that the variables in the "inexact design process group" were seen to have the most influence on waste generation at the design stage which is contrary to Osmani, Glass & Price (2008) which listed "last-minute changes in client's requirement and design changes by the design team" and Alwi, Hampson & Mahomed (2002) that identified unclear drawings, poor design, design changes, slow drawing revision and distribution, and unclear specifications as some major factors that affect building construction waste generation. Additionally, the findings from this study showed that there are no significant differences between the consultants' and contractors' perception regarding the factors affecting the generation of waste in building construction projects, as well as corroborating the findings by some previous scholars (Saidu & Shakantu, 2016; Adewuyi & Otali, 2013; Ameh & Itodo, 2013; Alwi et al., 2002).

5. Conclusion and Recommendation

From the analysis of the perception of the built environment industry stakeholders, the study concludes that, the causes of waste generation from the design stage activities of a building development are varied and dependent upon several groups of factors. This study identified 27 variables that were influential to waste generation from design stages of building projects. Consequently, this study recommends that policy should be directed towards: reducing waste generation from design stage activities of a building construction project; developing ways by which design stage activities can be reviewed and monitored in every building construction project;

professional bodies in the built sector should introduce courses in their continuous professional development (CPD) programmes that will enlighten practitioners of the problems of building construction waste generation and the consequences it portends to the environment;

References

Adewuyi, T., & Otali, M. (2013, November). Evaluation of Causes of Construction Material Waste - Case of Rivers State Nigeria. *6*, 746-753. doi:10.4314/ejesm.v6i6.5S

Akhtar, A., & Sarmah, A. (2018, March). Construction and demolition waste generation and properties of recycled aggregate concrete: A global perspective. *Journal of Cleaner Production, 186*. doi: {10.1016/j.jclepro.2018.03.085}

Ali, I. F., Awad, S., & Abdulsalam, D. (2019). Critical Factors Limiting the Performance of Small-Scale Construction Firms in Nigeria. *International Journal of Engineering Science Invention (IJESI), 8*(8), 46-57.

Alwi, S., Hampson, K., & Mahomed, S. (2002a). Non-value-adding activities: A comparative study of Indonesian and Australian construction projects. *In Proceedings of 10th International Group of Lean Construction Conference, Gramada, Brazil, (627-638), 10th August, 2002*.

Aniekwu, N. A., Anthony, C. I., & Onifade, M. K. (2015). Critical Issues in Reforming the Nigerian Construction Industry. *British Journal of Applied Science & Technology, 5*(3), 321-332..

Bekr, G. (2014, October). Study of the Causes and Magnitude of Wastage of Materials on Construction Sites in Jordan. *Journal of Construction Engineering, 2014*. doi:10.1155/2014/283298.

Choi, M., Takeshi, F., & Chin, S. (2018). Environmental Impacts of Construction and Demolition Waste. (S. Jeng, S. Wai, & J. Jiri, Eds.) *Chemical Engineering Transactions, 63*, 343-347. doi:10.3303/CET1863058.

Chowdhury, M., Upadhyay, A., Briggs, A., & Belal, M. (2016, May 8). An overview of green supply chain management practices in Bangladesh construction industries. *POMS Conference 2016*, 1-10. Retrieved May 5, 2021, from https://research.brighton.ac.uk/en/publications/an-overview-of-green-supply-chain-management-practices-in-banglad.

Dantong, J. S., Prucnal-Ogunsote, B., Okwoli, P., & Dassah, E. (2017). Unethical Professional Practices and Poor Craftsmanship of Construction Projects Performance in Nigeria: Consequences and the Way Forward. *Journal of Civil Engineering and Environmental Sciences*, *3*(1), 022-030. doi: http://doi.org/10.17352/2455-488X.000017.

De, Shaoli and Debnath, & Biswajit. (2016, December). Prevalence of Health Hazards Associated with Solid Waste Disposal- A Case Study of Kolkata, India. *Procedia Environmental Sciences*, *35*, 201-208. doi: 10.1016/j.proenv.2016.07.081.

Ekanayake, L., & Ofori, G. (2000, August). Construction materials waste source evaluation. . *Proceedings: Strategies for a sustainable built environment*, 23-25. Retrieved May 5, 2021.

Ferronato, Navarro and Torretta, & Vincenzo. (2019, March). Waste Mismanagement in Developing Countries: A Review of Global Issues. *International Journal of Environmental Research and Public Health*, *16*, 1060. doi:10.3390/ijerph16061060.

Ginga, C., Ongpeng, J. C., & Daly, K. M. (2020, July 3). Circular Economy on Construction and Demolition Waste: A Literature Review on Material Recovery and Production. *Materials 2020* (Recent Research in the Design of New Sustainable Building Materials). Retrieved May 5, 2021, from https://doi.org/10.3390/ma13132970.

Ibrahim, I. I., Silas, J., & Mohammed, M. M. (2019). Effects of craftsmen supervisors project management skills on construction project success in Nigeria. *IOP Conf. Series: Materials Science and Engineering, 5*(13), 1-10. doi:10.1088/1757-899X/513/1/012002.

Ibrahim, Saidu and Shakantu, & Winston and Winston. (2016, August). The contributions of construction material waste to project cost overruns in Abuja, Nigeria. *23*, 99-113. doi:10.18820/1023-0564.

Idoro, G. I. (2010). Influence of quality performance on clients' patronage of indigenous and expatriate construction contractors in Nigeria. *Journal of Civil Engineering and Management*, *16*(1), 65-73. doi:10.3846/jcem.2010.0.

Inuwa, I. I., Wanyona, G., & Diang'a, S. (2014). Indigenous Contractors Involvement and Performance in Construction Procurement Systems in Nigeria. *Global Journal of Researches in Engineering, xiv*(i), 1-13.

Irefin, I. A. (2013). Effects of Project Management on the Performance of a Construction Firm in Nigeria. *American International Journal of Contemporary Research, 3*(6), 54-58.

Kofoworola, O., & Gheewala, S. (2009, October). Life cycle energy assessment of a typical office building in Thailand. *Energy and Buildings*, *41*, 1076-1083. doi: 10.1016/j.enbuild.2009.06.002.

Lau, H., & Woods, P. (2008, January). An empirical study of learning object acceptance in multimedia learning environment. *Communications of the IBIMA*, *5*, 1-6. Retrieved May 5, 2021.

Nagapan, S., Abdul, R., Ismail, Asmi, Ade, . . . Rosli. (2012). Identifying Causes of Construction Waste -Case of Central Region of Peninsula Malaysia. *International Journal of Integrated Engineering*, *4*, 22-28.

National Bureau of Statistics (NBS). (2016). *Nigerian Gross Domestic Product Report (Q4 2016)*. Retrieved from, http://www.nigerianstat.gov.ng/report/518

Okoye, P. U., Ngwu, C., & Ugochukwu, S. C. (2015). Evaluation of management challenges facing construction practice in Nigeria. *International Journal of Application or Innovation in Engineering & Management (IJAIEM), 4*(1), 19-28.

Osmani, M. (2012, 12 31). Construction Waste Minimization in the UK: Current Pressures for Change and Approaches. *Procedia - Social and Behavioural Sciences*, *40*, 37-40. doi: 10.1016/j.sbspro.2012.03.158.

Osmani, M. (2011). Construction Waste. In T. M. Letcher and D. A. Vallero (Eds.), *Waste: A handbook for management*, (pp. 207-218). Oxford, UK: Elsevier.

Osmani, M, Glass, J and Price, A D F (2008) Architects' perspectives on construction waste reduction by design. Waste Management, 28, 1147-1758.

Oyenuga, A. (2014, March). Challenges in Managing Construction and Demolition Waste. *Journal of Solid Waste Technology and Management}*. Retrieved May 5, 2021.

Polat, G., Damcı, A., Türkoğlu H., & Gürgün A. P. (2017). Identification of roots causes of construction and demolition (C&D) waste: The case of Turkey. *Preocedia Engineering*, *196*(2017), 948-955.

Ryal-Net, M. B. and Kaduma, L. A. (2015). Assessment of Building Information Modelling (BIM) Knowledge in the Nigerian Construction Industry. *International Journal of Civil and*

Environmental Engineering IJCEE-IJENS, 15 (5), 1-10.

Saadi, N., Ismail, Z., and Alias, Z. (2016). A review of construction waste management and initiatives in Malaysia. *Journal of Sustainability Science and Management, 11*, 101-114. Retrieved May 5, 2021.

Sanneh, Edward Saja and Hu, Allen and Chang, Sanyang, & Edrisa. (2011, December). Introduction of a recycling system for sustainable municipal solid waste management: A case study on the greater Banjul area of the Gambia. *Environment, Development and Sustainability, 13*, 1065-1080. doi:10.1007/s10668-011-9305-9.

Shazwan, Muhammad and Quintin, J and Osman, Nurul and Kamarudin, Suhaida, S., & Ma'arof, M. (2017, November). The importance of cleanliness in a proper construction site management in malaysia: A contractor's perspective. *IOP Conference Series: Materials Science and Engineering, 271*, 012048. doi:10.1088/1757-899X/271/1/012048.

Tareq, K., & Ahmed, A.-Z. (2018). Major factors contributing to the construction waste generation in building projects of Iraq. *MATEC Web of Conferences, 162*(02034), 1-6. doi: doi.org/10.1051/matecconf/201816202034.

Tongo, S. O., Adeboye, A. B., & Oluwatayo, A. A. (2021). Life cycle assessment of material waste generation from building construction projects in Southwest Nigeria. *International Conference on Energy and Sustainable Environment, IOP Conf. Series: Earth and Environmental Science 665 (2021) 012061*, 1-11. doi:10.1088/1755-1315/665/1/012061.

Tongo, S., Oluwatayo, A., & Adeboye, B. (2020). Factors influencing Waste generation in buildings project in Southwest, Nigeria. *International Journal of Waste Resources, 9*(371), 1-4. doi:10.35248/2252-5211.19.10.371.

Udeaja, C., Ekundayo, D., Zhou, L., & Perera, S. (2013). *Material waste in the construction industry: a review of the legislative and supply chain issues, in Reuse of by products and materials in the construction industry.* Manchester: University of Salford. doi: dx.doi.org/10.1007/9781447153764_2.

Wahab, A., & Lawal, A. (2011, January). An evaluation of waste control measures in construction industry in Nigeria. *African Journal of Environmental Science and Technology, 5*. doi:10.4314/ajest.v5i3.71933.

Wayem, A. D., & Addo, H. (2015). Analysis of Criteria for Measuring Project Success in the Construction Industry of Ghana. *European Journal of Business and Management, 7*(29), 8-19.

Zheng, L., Wu, H., Zhang, H., Song, Q. (2017). Characterizing the generation and flows of construction and demolition waste in China. *Construction and Building Materials*, 136, 405– 413.