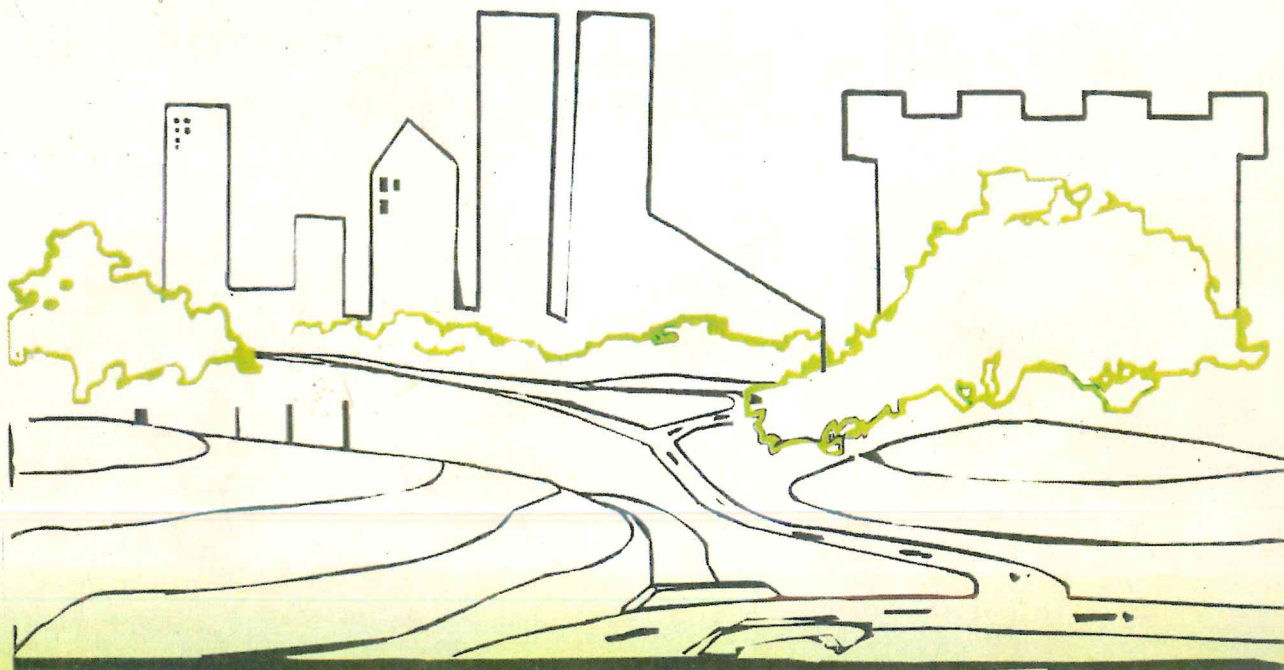


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A Journal of Faculty of Environmental Studies, University of Uyo, Uyo, Nigeria
Vol. 16, NO. 2, August, 2021



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EDITORIAL COMMENTS

Welcome to yet another volume of the Journal of Environmental Design. Volume 16 of the JED contains several thought-provoking well researched papers on the various dimensions of the built environment. It must be stated that environmental problems in general have become intricate phenomena requiring a wide range of interests and experts in their planning, management and design. The JED continues in its 16th volume to highlight the works of these experts and presents their informed views and cutting edge research findings for the benefits of policy makers and students of environmental studies. The papers have been peer-reviewed and carefully selected to ensure intellectual balance and intelligent discourse.

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EXAMINING THE CONSTRUCTION WASTE MANAGEMENT CONSTRUCT IN ABUJA NIGERIA: A VALIDATION STUDY

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Abstract

This study validates construction waste management (CWM) constructs among construction organisations in Abuja, Nigeria. Using a structured self-administered questionnaire, the data was duly collected from one hundred and seventy-eight project managers/managers of construction organisations. Partial Least Square – Structural Equation Model (PLS-SEM) technique was employed; the data was analysed using Smart-PLS 2.0 M3 software statistical package. Results of this study revealed that all the dimensions of technology readiness namely; optimism, waste recycling and waste reduction were highly relevant. Adequate level of internal consistency reliability, convergent validity and discriminant validity for each of the construct of the construction waste management were established. Based on the results, it is recommended that the CWM instrument could be useful for measuring all the constructs of construction waste management among construction organisations for the achievement of efficient and correct operative construction waste management practice.

Keywords: construction waste management, waste reduction, waste recycling, optimism, Abuja.

Introduction

The waste generation per unit output is greater in Nigeria compared with other developing world due to the inefficiency in construction processes (Opeyemi, 2012). Studies have been conducted by scholars to examine the problem of waste management in an attempt to address the issues associated with the construction and demolition waste management. For instance, a study was conducted on the practice and advantages of the onsite-waste reduction as well as the construction waste technology for the reuse of construction and demolition waste (Andersen, 2011). In a related study, Wang (2008) examined the on-site complexity of waste management through the use of a system dynamics approach; it was found that the lack of sufficient Waste Management skills and the use of traditional construction techniques were among the problems associated with waste management. In another study, it was revealed that, lack of motivation to execute the construction and demolition on-site reduction of waste contributed to the ineffectiveness in the management of construction waste. In addition, there is urgency for a set of government rules on Waste Management relatively with low charges of landfill in China (Yuan, 2008). Poorly designed landfill management creates unpleasant environmental impacts in African countries. Cases in point are, windblown waste, breeding pests, and fluid leaked generation. Also, one more basic result of landfills is the release of offensive gas, where the gas is transported from the anaerobic breakdown of the natural environment. The problems of odour created by the gas tend to destroy the natural vegetation and contribute to greenhouse gas (Nagapan, 2012). The ineffective and inoperative waste management practices among construction organisations necessitate for this study.

Review of Literature

Construction waste management has been considered as the collection, transport, treatment and disposal of waste including maintenance of disposal sites (Gbekor, 2003). According to Yusuf *et al* (2016) the construction waste management is referred to as the planning, coordinating, implementing, controlling, supervision and control of non-hazardous material waste or debris created or generated as a result of construction or demolition works to achieve optimum efficiency and better environmental quality. EL-Haggar (2010) stated further that, appropriate construction waste management will offer economic benefits by diminishing the project cost through appropriate waste management plan implementation. The model includes factors, for example, the series of construction activity, the types and the quantity of rate of construction materials, the material waste rate created, the resource availability and capability of waste collection bins, costs and incomes. The key objective of this model is to provide engineer's tool, and to allow the planners and contractors to focus on the best waste management plan situation for construction sites.

They closed by proposing a further development of the model to foresee and develop an efficient waste management. Their work focuses on the effect of waste management reduction. Garas *et al.* (2001) while

examining the construction industry in Egypt, identified the absence of waste management in the Egyptian construction industry plan before the execution stage among others as factors deemed responsible for material wastage. The government waste administration scheme in Hong Kong, obliges contractors to plan and actualise a waste management and carry out on-site sorting of waste before specific payments are made (Poon *et al.*, 2004). Likewise, McDonald and Smithers (1998) submitted that appropriate waste management has significantly helped waste from the site to be eliminated, where there was approximately fifty percent (50%) cost savings for handling charges of waste, fifteen percent (15%) of the volume of waste reduction close to reaching on site, and about forty three percent (43%) of waste reduction in landfill. Additionally, Poon *et al.* (2004) submitted that a point by point waste management plan is imperative for building sites to accomplish a sound waste management and waste reduction. Construction waste Management, renovation and demolition or destruction of projects are part of the growing movement to better manage materials and make sustainable communities. Building and demolition exercises are integrating "sustainability" or "green" management strategy design to ensure the environment, save resources (including financial resources), and monitor the energy to guarantee the prosperity of current and future generations.

Dimensions and Operationalisation of Construction Waste Management

The dimensions of construction waste management considered for this study include: Waste reduce and waste recycling.

Waste Reduction: Studies have shown that waste reduction regarded as "resource optimisation, is the most vital and the first step in waste prevention practice and materials efficiency". It consists of a set of actions to eliminate or reduce the quantity of on-site waste material utilisation before being disposed to landfill. For instance, reducing the quantity of packing that goes to the "site or using proficient framing techniques in reducing the amount of packaging that will be taken to site or using efficient framing techniques (Vleck, 2001). Gören (2015) maintained that another alternative way to reduce waste is to change design principles and practices as part of the waste reduction efforts. A modular basis structure should be designed by the architects that fit the utilisation of standard size materials. Additional to the modular plan, however, the estimating is very important. Any large quantities of materials brought to the construction site will at least be used, or stolen. Therefore, materials are sometimes transported to another job site for utilisation. Planning is the key to reducing; by thoroughly planning the entire construction process, reduction can simply be facilitated". Waste reduction is referred to as the most efficient construction waste management method. It is a way of minimising the production of construction waste, however, slashes the waste transporting, recycle and disposing cost (Esin and Cosgun, 2007).. However, previous researches extensively examined the waste reduction as the highest priority for managing construction waste.

Waste Recycling: Waste recycling includes waste being segregated into recyclable materials and non-recyclable materials. Therefore, the wastes that are recyclable are somehow reused; normally in the production of new materials using recycled materials. Virgin materials are replaced with recycled material, thereby protecting and preserving natural resources and energy. However, the economy will be improved through the adoption of this recycling method, also by way of supporting both occupations and creating investment opportunities. Therefore, the recycling industry had employed over 13,000 individuals in Florida (Victoria, 2005). Steps to reduce the disposal of waste in landfills have been achieved by some developed countries such as Hong Kong and Germany. Recycle activities have been supported by the Germany government very well. An investigation of the lightweight concrete raw material demonstrates the country's commitment to sustainability. Hence, it indicates that there is full commitment for adopting green practice in their country (Kralj, 2011).

Research Method

This study used Nigerian construction organisations as the target respondents, 178 out of the 331 managers participated in this study. In particular partial least square (PLS) demands considered smaller sample size. The minimal recommended range for PLS is 30 to 100 cases, being at the organisational level of analysis. The sample size of this research is rather small (that is, 30 or less in the pilot study and 178 or less in the main study).

In this regard, GPower 3.1 was employed to acquire better sample size. According to the result obtained from GPower statistics, the suitable sample size of 331 was measured having power ($1-\beta$ err prob. = 0.95). Moreover, according to Sekaran and Bougue (2013), the ideal sample would be 89. In the light of aforementioned discussion, the study managed to get response from 178 respondents, whereas the survey was self-administered which is the most suitable approach if the survey is limited to locality where potential respondents can be approached. Though taking care of an important factor of "heterogeneity of sample, the number of variables used in the study and intended statistical tool to be used for the data analysis", the choice of proportionate stratified random sampling was made and utilised. Proportionate sampling approach is simpler, easier, appropriate, and more affordable to collect data from one or multiple strata, compared to other sampling techniques. Keeping in view the total numbers of eligible respondents in every stratum which is the project managers of construction organisations in Abuja-Nigeria, samples were randomly selected. This study validates the construction waste management (CWM) constructs in the context of construction organisations in Nigeria. Using a structured self-ministered questionnaire, the data was duly collected from one hundred and seventy eight project managers of construction organisations. Keeping in view the prime importance of the phenomenon, this study investigates construction waste management among construction organizations.

Results and Discussion

Demographic profile

The respondents' demography is provided in Table 1 where category of organisation, designation, age, marital status, gender, qualification and years of organisations' operation are displayed. This study shows that among the four categories of construction organisations in Nigeria, category C constituted 69 responses, representing (38.7 %) of the total response, followed by category D with 44 responses, representing (24.7%), the next is category B with 38 responses, representing (15.3 %) and lastly category A had 27 responses representing (15.3%). Regarding the designation, 178 responses (100 %) are managers of construction organizations in Nigeria. As regard the age, 98 out of the total responses representing (55%) are between the age of 26 – 50years, then between 51 – 70with 56 responses (31.5%), and finally age group between 18 – 25 years with 24 responses (13.5%). In terms of the marital status of the respondents, the married dominated with 124 responses (69.7percent) while the Single had 54 responses (30.3%). Most of the responses in this study were given by male with 161 responses or 90.4 percent while the female had 17 responses, representing 9.6 percent. In terms of the educational qualification, those with PGD/Master's Degree holders constituted 86 responses or 48.2 percent of the total responses, followed by HND/Degree holders with 56 responses which represent 31.5 percent. Those with PhD certificates were 30 in number; representing 16.9 percent while finally those with other certificates amounting to 4 responses represent only 3.4 percent of the total responses. This points out clearly that majority of the construction organisation managers are the holders of PGD /Master's degree certificate followed by HND/Degree holders, and the next are those with PhDs and lastly other certificates with the least percentage of (3.4%) which is insignificant. In the meantime, with regard to the number of years in operation, 100 respondents had between 11 – 21years in operation (56.2%), 49 respondents (27.5%) had less than 10 years, 26 respondents (14.6%) had between 21 – 30years of existence, whereas 31 – 40years accounted for the least number of respondents of just 3(1.7%).

In validating the construction waste management among construction organisations in Nigeria, PLS path modelling was employed to investigate the data by using Smart-PLS 2.0. Equally the PLS-SEM is good for better forecasting and analysing statistical framework. As a familiar second generation structural equation modelling technique (Ringle, Wende & Will, 2005; Wold , 1982), it is considered as a useful and appropriate tool to analyse complex model and real time applications, The development and validating of complex model are been carried out with PLS path modeling (Zhao and Chua 2003; Zhao and Chua 2003; Akter, D'Ambra & Ray 2011; Fornell & Bookstein 1982; and Hulland 1999). Additionally, PLS allows the use of multiple outcomes variables at the same time, calculates error model and direct computation and incorporation of moderator into a model. Non-normal data is accepted by PLS in social science studies as one of the common issues.

Table I: Demographic

Demographic Variables	Category	Frequency	Percentage
Category of organisations	Category A	27	15.3
	Category B	38	21.3
	Category C	69	38.7
	Category D	44	24.7
Designation	Manager	178	100
Age	18-25years	24	13.5
	26-50years	98	55.0
	51-70years	56	31.5
	70 and above	0	0.00
Marital status	Single	54	30.3
	Married	124	69.7
Gender	Male	161	90.4
	Female	17	9.60
Educational qualification	HND/Degree	56	31.5
	PGD/Masters	86	48.2
	PhD	30	16.9
	Others	6	3.40
Years of operation	Less than 10years	49	27.5
	11-20years	100	56.2
	21-30years	26	14.6
	31-40years	3	1.70

SEM has been endorsed as one of the most trustworthy statistical tools for social and behavioural sciences that allows the investigation of more than one relationship simultaneously. While following the analysis mood and objectives to validate construction waste management constructs, measurement model approach was employed in the study (Figure 1). Items validity, individual reliability, internal consistency, convergent validity and discriminant validity by looking at three values: outer loading, average variance extracted (AVE) and the composite reliability (Henseler, Fornell & Larcker 1982; Barclay *et al.* 1995). Hulland (1999) suggests that values of AVE and outer loadings should be greater than 0.5 each. Composite Reliability, according to Hair *et al.* (2011) should be greater than 0.7. Hulland (1999) recommended that items with loading values of less than 0.4 should be deleted.

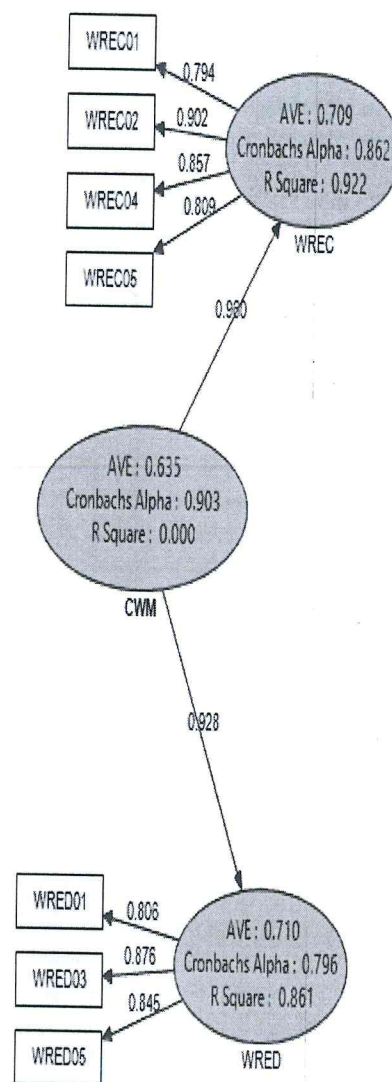


Figure I: Measurement Model

Table 2: Results of the confirmatory factor analysis for Construction Waste Management

Code	Indicators	1	2
WREC01	Our organisation Management Support waste recycling	0.79	
WREC02	Our organisation Set Goals for recycling waste	0.90	
WREC04	Our organisation is Finding Markets for recycled waste	0.85	
WREC05	Our organisation encourages education and Motivation for waste recycling	0.80	
WRED01	In our organisation, we avoid damage by handling and storing materials properly		0.80
WRED03	In our organisation, we use materials efficiently and use less of them		0.87
WRED05	In our organisation, we reduce the use of non-recyclable materials		0.84
	Average Variance Extracted (AVE)	0.70	0.71
	Cronbachs Alpha (CA)	0.86	0.79
	Composite Reliability (CR)	0.90	0.88

WREC=Waste Recycling, WRED= Waste Reduction

Individual Item Reliability: In confirming the component of individual reliability, each item reliability of construction waste management scale is considered. The Individual item reliability was assessed through outer loadings. Usually, the bench mark for the outer loading value of 0.4 and above is considered to validate individual item reliability (Duarte and Raposo, 2010; Hair, 2014). Further the standardized loadings for all the 11 items were observed; 7 items associated with waste reduction and waste recycling were found greater than the standard cut-off i.e. above 0.4, whereas four items (WREC03, WRED02, WRED04 and WRED 06) from "Waste Recycling and Waste Reduction" were removed due to the lower value. In total, 7 point loadings ranged between 0.79 and 0.90, were kept. Following Nasidi, Bamgbade, Adeleke, and Ali (2016) all the retained items sufficiently met the acceptable criterion set for individual item reliability.

Internal Consistency Reliability: The internal consistency reliability can be defined as "the degree to which every item in an individual scale (or sub scale) measures the same concept" (Bijttebieret *et al.*, 2000; Duarte & Raposo, 2010). Two methods i.e. Cronbach's alpha coefficient and composite reliability, have been widely employed for internal consistency reliability assessment (Bacon, Sauer and Young 1995; McCrae, Kurtz, Yamagata, and Terracciano 2011; Peterson and Kim 2013). This study, while following the suggestions of Hair *et al* (2011) and Bagozzi and Yi (1988), employed cronbachs Alpha and composite reliability coefficient for the assessment of internal consistency reliability of the construction waste management (CWM). According to Bagozzi *et al.* (1988), Wong *et al.* (2013), Nunnally *et al.* (1997), Chin (1998), and Hair *et al.* (2011), the cronbachs Alpha and the composite reliability should be greater than 0.7. The composite reliability coefficients, provided in Table 2, retained the value ranged between 0.796 and 0.862. While the composite reliability ranges between 0.88 and 0.97. The acquired values of coefficient retained shows that, all the variables of this study confirmed sufficient internal consistency reliability (Hair *et al.*, 2011).

Convergent Validity: Convergent validity is defined as "the degree by which items truly represent the intended latent constructs and correlate with other measures of the same latent construct Hair et al., 2006. The convergent validity was established considering the average variance extracted (AVE) of the latent constructs obtained. According to Chin (1998), the AVE loadings for each of the latent construct should be 0.5 or above. Table 2 shows that the AVE obtained for waste recycling and waste reduction were found greater than required cut-off value i.e. above 0.5 and valued as 0.709 and 0.710 respectively.

Discriminant Validity: Discriminant validity can be defined as the level to which a certain item varies from the other one (Hulland, 1999). According to Chin (1998), it can be measured by assessing the cross-loadings by following the rule where "the items should have a higher correlation with the latent variable that they are supposed to measure than with any other latent variable in the model". Further, the square root of the AVE for each construct can be used to examine the discriminant validity. According to Fornell and Larcker (1981), the square roots of AVE coefficients should be placed in the correlation matrix next to the side of the diagonal. The results are considered confirmed for the discriminant validity, if the squared AVE

is found greater than squared correlation estimates, where "the diagonal coefficients or elements must be greater than the off-diagonal coefficients or elements in the corresponding rows and columns" (Chin, 1998, Hair et al 2006). Keeping in view the above mentioned criterion, table 3 provides the confirmation of discriminant validity.

Table 3: Discriminant Validity

Latent Variable Correlations	1	2
Waste Recycling	1.492	
Waste Reduction	0.787	1.493

The boldface values shown in Table 3 are square root values of the average variance extracted. Since, all the values of square root of AVE were greater than the correlations, the AVE values show that all the latent constructs have successfully confirmed sufficient level of the discriminant validity (Ali, Nawanira, Nasidi and Bamgbade, 2016). Hence, it can be concluded that all the measures of the CWM have met the discriminant validity requirements.

Discussion and Conclusion

Vleck (2001) established a construction waste reduction and waste recycling questionnaire to facilitate study in investigating the integrated waste management. A thorough literature review made it obvious that integrated waste management have been studied in the perspectives of developed and Asian countries. For the reasons present, the study investigates construction waste management among construction organizations in Abuja Nigeria, according to World Bank Report 20014 a country with a population of over 178 million, with high construction activities to meet the infrastructure need of the populace in terms of residential, commercial, agricultural, transportation and other land use purposes, lead to the creation of large quantities of construction waste with little attention on effective and efficient waste management system. Empirically, construction waste management related studies show inconsistent results. This study validated CWM constructs among construction organisations in Abuja, Nigeria. The targeted population for this purpose was the construction organisations. All the constructs have met the criterion and proved that the construction waste management constructs are appropriate to measure construction waste management among construction organizations in Abuja. Results of the confirmatory factor analysis, reliability, and validity tests established the appropriateness of CWM dimension i.e. waste recycling and waste reduction. For the prospect study, the scale can be studied further in the different perspective.

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