Strategies for Reducing Materials Wastage in a Building Construction Site

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Abstract

The purpose of this study was to investigate on how to reduce materials wastage in a building construction site,and to look into the measures that will reduce wastage from the beginning to finish. The descriptive survey research design was used in the study. Two research questions, and two null hypotheses were formulated to guide the study.The population of the study consisted of 205construction professionals in building construction organizations operating in Uyo,Akwa IboState. A stratified sampling technigue was used to draw 44 respondents through random sampling technigue. An instrument titled Reducing Materials Wastage in a Building Construction Site Questionnaire(RMWBCSQ) was used to gather data for the study.The instrument was validated by three experts in the Department of Vocational Education,and Educational Management and Planning in University of Uyo,Uyo. For its internal consistency, the Cronbach Alpha reliability technigue was used, which yielded a reliability coefficient of 0.81. Data collected were analyzed using mean and independent t-test. The findings revealed among others that: materials storage and handling, operational, design and documentation, procurement are some sources and causes of materials wastage. It was therefore recommended that: Government should enact laws and establish policies that will engender positive attitudes towards waste reduction at all levels in a construction project site, proper site and waste management techniques, and preparation of accurate specification for materials.

Keywords: Materials Wastage, Construction, Building Project

Introduction

The construction industry encounters severe problems resulting from huge amounts of waste hence, the need to curb the wastage issue (Polat and Ballard, 2004). Studies have shown that waste can arise at any stage of the construction process from inception, design, construction and operation of the built project (Al-Moghany, 2006, Smallwood, 2000). Waste in the construction industry has been the subject of several research projects around the world in recent years (Teo and Loosemore, 2001; Smallwood, 2000). According to Polat and Ballard (2004), it is commonly acknowledged that a very high level of waste exists in construction. Since construction has a major and direct influence on many other industries by means of both purchasing inputs and providing the products to all other industries.

Waste according to the new production philosophy is the inefficiency that results in the use of equipment, materials labour, or capital in larger quantities than those considered as necessary in the production of building.Waste includes both the incidence of material losses and the execution of unnecessary work, which generates additional cost but do not add value to the product(Polat and Ballard,2004). Waste can be classified as *unavoidable waste* (or natural waste), in which the investment necessary for its reduction is higher than the economy

produced, and *avoidable waste,* in which the cost of waste is higher than the cost to prevent it (Formoso,2002). The percentage of unavoidable waste depends on the technological development level of the company. Formoso, (2002), also stated that waste can also be categorized according to its source; namely the stage in which the root causes of waste occurs. Waste may result from the processes preceding construction, such as materials manufacturing, design, materials supply, and planning, as well as the construction stage.

Materials wastage according to Wong (2002). Building materials waste can also be defined as the difference between the value of materials delivered and accepted on site and those properly used as specified and accurately measured in the work, after deducting the cost saving of substituted materials transferred elsewhere, in which unnecessary cost and time may be incurred by materials wastage(Shen and Tam, 2000).

Based on the above, wastage in the construction industry can also be defined as loss or destruction of valuable things (that is something valuable that has not been used carefully). It can also mean the degree to which the actual construction industry's output fails to correspond with stated goals of the industry within a given period of time. Waste in the construction industry has been the subject of several research projects around the world in recent years(Wong, 2002,Teo andLoosemore, 2001, Smallwood, 2000). Construction site waste can be described as the non- hazardous by- product resulting from activities during new construction and renovation. It is generated during the construction process because of factors such as site preparation,material use, material damage, material non-use, excess procurement and human error (Mocozoma, 2002).Some of the materials that are wasted on the construction sites include steel reinforcement bars,concrete, timber formwork, bricks and blocks,cement,mortar,tiles pipes, aggregates(Shen,2002).

Materials wastage can be caused by the following, but not limited to, Poor workmanship,Inadequacy and defective facilities, Under-utilization of the resources, Mismanagement of resources,Prolong storage of consumable materials etc.This wastage can also be controlled among others ;buying schedule, materials scheduling, ordering materials progressing, deliveries, communication and coordination on site. A building construction site is a place or plot where building construction activities are going on.

For the sake of this study, only materials wastage at the building construction site would be considered. This is due to two main reasons:

1. Materials account for the largest input into construction activities in the range of 50-60% of the total cost of a project (Ibn-Homaid, 2002; Ganesan, 2000)
2. The raw materials from which construction inputs are derived come from non-renewable resources. Hence, rarely would these materials be replaced once they are wasted (Ekanayake and Ofori, 2000).

Statement of the problem

Research indicates a wide variation in wastage rates of between 5% - 27% of total materials purchased for construction projects. The current liberal global economic order makes it challenging for building industries to remain competitive worldwide. The industry must therefore strive to deliver valuable products and services at the minimum possible cost for their customers in order to remain in the business. In order to achieve minimum cost in construction, building industry must appreciate the difference between waste and value and how to eliminate waste in the projects which are carried out. Building project considers construction materials wastes as potential wastes that hinder flow of value to the client and should be eliminated. The creation of this waste can be prevented by applying building project principles. The question now arises as to whether professionals in the building

industry are aware of the amount of materials waste generated on site. What measures have they put in place to deal with the situation?

Purpose of the Study

The main purpose of this study is to examine how to reduce materials wastage at the building construction site . Specifically, the study sought:

1. To identify and prioritize influential barriers to successful implementation of a building project.

2. To propose measures that has the potentials of reducing materials waste in a building project.

Research Questions

The following research questions guided the study:

1. What are the potential barriers that hinder the implementation of a building project?

2. What are the measures that have the potentials of reducing materials waste in a building project?

Null Hypotheses

The following null hypotheses guided the study and were tested at 0.05 level of significance:

$H0_1$: There is no significant relationship between the influential barriers and successful implementation of a building project.

$H0_2$: There is no significant relationship between the measures that have the potentials of reducing materials waste and the implementation of a building project.

Methodology

The study was carried out in Akwa Ibom State. Survey research design was used for the study. Survey research design involves systematic collection and presentation of data from a sample of the study using questionnaire. The design was suitable for the study because a questionnaire was used to collect data from a sample of construction professionals

. The target population for this study is 205 construction professionals in Uyo, Akwa Ibom State. Stratified random sampling techniques was used to draw 22 for private construction professionals and 22 for public construction professionals. The strata were under private and public construction professionals.

A researcher-developed instrument entitled “Reducing Materials Wastage at a Building Construction Site Questionnaire (RMWBCSQ)” was used to gather data for the study. The RMWBCSQ instrument had two main sections; A and B. Section A of the instrument was designed to gather respondents’ personal data. Section B contained 21 items on a four point scale with options ranging from Strongly Agree (SA), Agree (A), Disagree (D) and Strongly Disagree (SD) to which respondents were required to tick (√) options that best described their views. Three experts from the Departments of Vocational Education, and Educational Management and Planing , University of Uyo validated the instrument. Their corrections and suggestions were used to improve the initial copy for production of the final version of the instrument. The internal consistency of the instrument items was determined using Cronbach Alpha reliability estimate which yielded 0.81.Copies of the instrument(RMWBCSQ) where

administered by the researcher with the help of two research assistants, and completed copies where collected on the spot. Mean statistics was used to answer research questions while independent t-test statistics was used to test the null hypotheses at 0.05 level of significance. The mean for the value attached to the response scale of the questionnaire was computed as follows: 4+3+2+1=10/4=2.50. This implies that any item with a mean of 2.50 and above was regarded as agreed while those below 2.50 were regarded as disagreed.

Results

The data collected for the study are presented based on the research questions and hypotheses of the study.

Research Question 1: What are the potential barriers that hinder the implementation of a building project?

Table 1: Mean Analysis of the Responses on Barriers that Hinder Implementation of a Building Project.

S/No	Barriers Hindering Building Project Implementation	N	Ẋ	Decision
1	Extensive use of subcontractors hinder the implementation of a building project	44	2.73	Agree
2	Lack of long term relationship with suppliers hinders the implementation of a building project.	44	2.80	Agree
3	Delay in materials delivery hinder the implementation of a building project	44	2.93	Agree
4	Lack of technical skills hinder the implementation of a building project	44	3.00	Agree
5	Wrong design hinder the implementation of a building project	44	2.91	Agree
6	Lack of equipment hinder the implementation of a building project	44	2.95	Agree
Grand Mean		**44**	**2.89**	**Agree**

As shown in table 1, respondents agreed on extensive use of subcontractors hinder the implementation of a building project, lack of long term relationship with suppliers hinders the implementation of a building project, delay in materials delivery hinder the implementation of a building project, lack of technical skills hinder the implementation of a building project, wrong design hinder the implementation of a building project and lack of equipment hinder the implementation of a building project. The table also showed that on the whole (grand mean), respondents agreed on the views of potential barriers that hinder the implementation of a building.

Research Question 2: What are the measures that have the potentials of reducing materials waste in a building project?

Table 2: Mean Analysis of the Responses of Respondents on Measures of Material Waste Minimization

S/No	Measures of reducing Materials Waste	N	Ẋ	Decision
1	Purchasing new materials that are just sufficient have the potentials for reducing materials waste through the implementation of a building project.	44	2.70	Agree
2	Good coordination between store and construction personnel to avoid over ordering have the potentials for reducing materials waste through the implementation of a building project.	44	2.82	Agree
3	Use of more efficient construction equipment have the potentials for reducing materials waste through the implementation of a building project.	44	2.68	Agree
4	Proper storage of materials on site have the potentials for reducing materials waste through the implementation of a building project.	44	2.84	Agree
5	Mixing, transporting and placing concrete at the appropriate time have the potentials for reducing materials waste through the implementation of a building project.	44	2.82	Agree
6	Adherence to standardized dimension have the potentials for reducing materials waste through the implementation of a building project.	44	2.82	Agree
7	Vigilance of supervisors have the potentials for reducing materials waste through the implementation of a building project.	44	2.77	Agree
Grand Mean		**44**	**2.78**	**Agree**

As shown in table 2, respondents agreed on purchasing new materials that are just sufficient,good coordination between store and construction personnel to avoid over ordering, use of more efficient construction equipment, proper storage of materials on site, mixing, transporting and placing concrete at the appropriate time, adherence to standardized dimension and vigilance of supervisors have the potentials to reduce materials waste through the implementation of a building project.

Hypothesis 1: There is no significant difference between the responses of public and private professionals on the views of professionals on materials waste reduction.

Table 3

Independent t-test Analysis of Responses of Public and Private Professionals Based on the Views of Professionals on Materials Waste Reduction

Professionals	**N**	$\overline{X}$	**SD**	**df**	t_{cal}	**P-value$_{cal}$**
Public	22	17.18	3.62			
				42	0.24	$.81^{NS}$
Private	22	17.45	3.93			

^{NS} = Not Significant at .05 level of significance

As shown in Table 3, the calculated P-value (.81) is greater than the significant level (.05). Therefore, the null hypothesis is retained. This implies that there exists no significant difference between the responses of public and private professionals on the views of professionals on materials waste reduction.

Hypothesis 2:

There is no significant difference between the responses of public and private professionals on the measures that have the potentials of reducing materials waste in a building project.

Table 4: Independent t-test Analysis of Responses of Public and Private Professionals Based on the Measures that Have the Potentials of Reducing Materials Waste in a Building Project.

Professionals	N	$\overline{X}$	SD	df	t_{cal}	P-value$_{cal}$
Public	22	19.73	3.857			
				42	0.45	.66^{NS}
Private	22	19.18	4.182			

^{NS} = **Not Significant at .05 level of significance**

As shown in Table 4, the calculated P-value (.66) is greater than the significant level (.05). Therefore, the null hypothesis is retained. This implies that there exists no significant difference between the responses of public and private professionals on the measures that have the potentials of reducing materials waste in a building project.

Discussion of Findings

The findings of the study on the potential barriers that hinder the implementation of a building project indicated no significant difference between public and private professionals' responses. The findings also indicated that the professionals agreed to the potential barriers that hinder the implementation of a building project. The result could be attributed to professionals seeing avoidance of defects in works done as reduction of material waste, building and maintaining long term relationships with suppliers as reduction of material waste and delivering what the client wants reduces material waste. The finding is in line with that of Shant and Daphene, (2014), asserted that alternative construction methods and material may be incorporated during design in other to eliminate or reduce waste generated in construction.

The findings of the study on the measures that have the potentials of reducing materials waste in a building project indicated no significant difference between public and private professionals' responses. The findings also indicated that the professionals agreed to the measures that have the potentials of reducing materials waste in a building project. The result could be attributed to professionals seeing purchasing new materials that are just sufficient, good coordination between store and construction personnel to avoid over ordering, use of more efficient construction equipment, proper storage of materials on site, mixing, transporting and placing concrete at the appropriate time, adherence to standardized dimension and vigilance of supervisors as potentials to reducing materials waste through the implementation of a building project. The finding is in line with that of _Ibn-Homaid (2002), concluded that proper storage of materials on site , mixing, transporting and placing concrete

at the appropriate time, adherence to standardized dimensions, purchasing raw materials that are just sufficient are measures that have the potential of reducing material waste through the implementation of a building project.

Conclusion

Based on the findings, it is concluded that, purchasing raw materials that are just sufficient, using materials before expiry dates, good coordination between store and construction personnel to avoid over ordering, use of more efficient construction equipment and adoption of proper site management techniques are of most importance when talking about measures which can reduce the wastage of materials in the building construction site. Encouraging re-use of waste materials in projects and engaging in these waste reduction measures would do much more for the present economy.

Recommendations

Based on the findings and conclusion of the study, the following recommendations were made:

1. In order to assist the construction industry to reduce wastage of materials, it is recommended that government should enact laws and establish policies that can engender positive attitudes towards waste reduction in a building construction site.

2. Proper site and waste management techniques, and preparation of accurate specifications for materials are recommended measures to adopt in the quest to reduce materials waste in construction.

REFERENCES

Al-Moghany, S. S. (2006). Managing and minimizing construction waste in Gaza strip. A thesis submitted to the Islamic University of Gaza- Palestine

Aggarwal J.C. (2008). Psychology of learning and development. Delhi: Shipra Publications.

Chen, Z., Li, H., Wong, C.T.C. (2002). An application of bar-code system for reducing construction wastes. *Automation in Construction,* 11 (5), 521–533.

Ekanayake L. L. and Ofori, G. (2000). Construction material waste source evaluation. In: *Proceedings of the Second Southern African conference on sustainable development in the built environment, Pretoria*, 23–25 August 2000, 25 (35), 1–6.

Formoso, C. T.(2002). Materials waste in building industry: *Main causes and prevention. Journal of construction engineering and management*, 128(4), 316-325.

Ganesan, S. (2000). Employment, technology and construction development, Ashgate Publishing Company, Aldershot.

Ibn-Homaid, N. T., (2002). A comparative evaluation of construction and manufacturing materials management. *International journal of project management,* 20,263-270.

Mocozoma, D. S. (2002). Construction site waste management and minimization: international report, International Council for Research and Innovation in Buildings, Rotterdam, available at: *www.cibworld.nl/pages/begin/Pub278/06Construction.pdf.*

Polat, G. and Ballard, G. (2004). Waste in Turkish Construction- Need for lean construction techniques. *In proceedings of the 12th annual conference of the international group for lean construction IGLC,* 12 (8), 488-501.

Shant, A.D. and Daphene, C. K. (2014). Waste management models and their applications on construction sites. *International journal of construction engineering and management*, 3(3), 91-98.

Shen, L. Y., and Tam, V. W. Y. (2000). Material wastage in construction activities-a Hong Kong survey. In: Proceedings of the first CIB-W107 International Conference: creating sustainable construction industry in developing countries, 125-131.

Shen, L. Y. (2002). *An examination on the waste Management practice in the local construction site, Hong Kong Surveyor,* **13**(1), 39-48.

Smallwood, J. J. (2000). Construction and the environment-general contractor (GC) perceptions and practices. In: Proceedings of the first CIB-W107 International Conference: creating sustainable construction industry in developing countries, 155-164.

Teo, M. M. M. and Loosemore, M. (2001). A theory of waste behaviour. *Construction management and economics,* 7 (19), 741-751.

Wong, P.G. (2002). Technology and construction development,Ashgate Publishing Company, Aldershot