# Construction Waste Management Application in Building Projects

Ahmed Zaharadeen Shola<sup>1</sup>, Agboola Shamsudeen Abdulazeez<sup>2</sup>, Abbas Mashood<sup>3</sup>, Ubaida Usman Aliyu<sup>4</sup>

<sup>1,2,4</sup>M.Tech Students, Abubakar Tafawa Balewa University Bauchi, Nigeria <sup>3</sup>M.Sc Student, Ahmadu Bello University Zaria, Nigeria

Abstract: Construction waste management at all stages of construction process is a major concern in the construction industry because of the strife to improve performance in terms of cost, quality and sustainability. Ineffective material management add to cost of storing and transporting of construction waste, along-side loss of revenue from not reclaiming waste materials, knowing its financial implication precede construction companies to take actions in minimizing waste. In other words this will creates an atmosphere conducive enough to solving materials user supplier problems in terms of reduction in cost of materials, better quality control and improved labour productivity. As such the aim of this paper is to assess construction waste management application in building projects, with specific objectives of assessing material management practice by construction firms, to also identify the factors militating against materials management, to asses impact of waste on building projects performance, and to find out measure for effective material management. Fifty (50) questionnaires were administered to professionals including architects, builders, civil engineers, quantity surveyors, and other professional's engaged in the process and production of building element. Frequency, mean and standard deviation was used for the analysis. The study identified receiving and verification of materials on site, possession of qualified staff and Possession of required equipment as major factors militating against materials management. Also construction wastes creates environmental and health problems, waste consumes resources and time without adding value to the client and wasteful activities in building projects reduce the contractors' profit margin are those factors which have high impact on building project performance. In addition Timely placing of orders for materials, Ensuring quality assurance and control processes are in place and making the store safe from theft and vandalism are the major measures required for effective material management for building project. It is therefore recommended that there should be awareness programs for all construction companies on construction materials management and handling. Also formal education should be given to storekeepers and the foremen on effective materials handling systems.

*Keywords*: Construction waste (CW), Construction waste Management (CWM), Building Project Performance (BPP)

#### I. INTRODUCTION

The present state of the building construction industry in Nigeria reflect various problems ranging from delays in project execution/delivery, substandard work, disputes, to cost and time overrun as a result of material shortage and wastages

The from theft and vandalism are<br/>effective material management<br/>about 30% of all was<br/>contribute between 50-65.<br/>Waste occurrences on si<br/>causes of waste in cons<br/>consequences of materials account for abo<br/>they are scarce resources<br/>up as waste through sev<br/>regard, [6] reveals cau<br/>projects as poor supervis<br/>unskilled labour, wrong

on sites, theft and displacement of materials, as well as poor accounting and security system of the concerned sites [1]. According to [2] lack of materials not only causes delays, but a consequent decrease in productivity which results in cost overruns. This is no doubt lack of effective material management is one of the major cause of waste in construction. Materials, as one of the resources employed by the building construction projects passes through a number of processes before they are finally incorporated in the actual construction. Great concern has been expressed in the recent years regarding waste of materials and their management in building construction projects in the whole world; this has led to most developed countries to search for better alternatives on how to manage waste in the building construction projects. However developing countries are still facing this problem and the research on this topic will be on what to do either to reduce or avoid and manage materials waste in our local building construction projects. However these processes bring about inadequacies of the materials such that at the end not all the materials procured and delivered to sites are used for the purpose for which they are ordered. This excess loss in materials is what is called waste. Even though material loss may be inevitable, but where it reaches unacceptable level that can affect the cost, quality and standard of the construction to clients and contractors, the need arises for economic use of construction materials by reducing the wastage to a minimum.

According to [3] construction and demolition are the largest contributors of waste (in the UK), responsible for generating about 30% of all waste. It is estimated that materials contribute between 50-65% of the total cost of a building [4]. Waste occurrences on sites are diverse but the most common causes of waste in construction projects are materials. The consequences of materials waste are enormous because materials account for about 50% to 60% construction cost and they are scarce resources. Lot of materials that get to sites end up as waste through several sources as opined by [5]. In this regard, [6] reveals cause of materials waste in Nigerian projects as poor supervision, design error, defective materials, unskilled labour, wrong quality materials, changes in design, specification errors, poor storage facilities, poor handling process, poor material scheduling, poor product information, wrong suppliers advice and bulk purchase which leads to excess. Construction sites suffer from ineffective administration and inefficient utilization of materials due to lack of proper knowledge of material management. Also, the inefficient material management has led to material wastage which inadvertently leads to abuse of contract agreement through factious claims and material rationing so as to cover loses, other problems include the execution of substandard works which at long run led to a more costly work than they should be.

[7] Posits a chronological view of material management as a line of responsibility, which begins with the selection of suppliers and ends when the materials are delivered to the point of use. Material management is a name applied to management function which coordinates and controls these activities in organization responsible for the purchase of materials, their scheduling from suppliers and from internal source, their handling, storage and procurement through the organization and their delivery to the customer. It is also responsible for the control of inventory, associated with work study and layout planning [8]. According to [9] waste amount management connotes reducing the and environmental effect of waste generated via reducing the amount of materials used or re-using existing materials. The materials management system attempts to ensure that the right quality and quantity of materials are appropriately selected, purchased, delivered and handled on site in a timely manner and at a reasonable cost [10]. Furthermore the successful construction materials management requires adequate input of all persons involved in a construction process. However the aim of this study is to reveal these causes and useful management techniques using some selected construction firms in Jos, Nigeria. This will ultimately influence projects' performance in terms of waste minimization.

# II. LITERATURE REVIEW

#### Material Waste in Construction

Constructions waste has been described by the building research establishment [11] as "the difference between the quantity of materials used in a project to that purchased. According to [12] construction materials waste refers to materials from sites that are unusable for the purpose of construction and have to be discarded for whatever reason. Construction material waste was also defined as any material apart from earth materials, which need to be transported somewhere else from the construction site or used in the site for any other purpose from the intended specific purpose on the project due to damage, excess or nonuse or which cannot be used due to non-compliance with the specification or which is by product of the construction process [13]. There are differing views held by researchers as to what constitutes Construction waste, construction waste is also defined by [11] as the by-product generated and removed from construction, renovation and demolition from building sites. According to [14] construction is can be any inefficiency that results in the

use of equipment, materials, labour, or capital in larger quantities than those considered necessary in the production of a building. [15] defined material wastages from buildings 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 savings of substituted materials transferred elsewhere, in which unnecessary cost and time may be incurred by material wastages.

Construction and Demolition waste is a complex waste stream, made up of a wide variety of materials which are in the form of building debris, rubble, earth, nails, concrete, steel, timber, and mixed site clearance materials, arising from various construction activities including land excavation or formation, site clearance, demolition activities and building renovation. However, material waste has been recognized as a major problem in the construction industry that has important implications both for the efficiency of the industry and for the environmental impact of construction projects [16]. Most construction wastes which were previously regarded as inert have been found to generate harmful leachates which have negative effects on the environment [17]. As such, it is absolutely imperative for the construction industry to adopt ecologically sound planning and construction practices for the purpose of creating a healthy and sustainable built environment [18]. It would not be right to point directly to a particular team on a construction site to say that they are responsible for a particular waste occurrence. Definitely, for waste to occur there must have been a lapse in the management structure of all concerned in the project. Therefore, all the members concerned are to be blamed for any waste. Material suppliers, site managers, site operatives are also not exceptional in this context. The construction design rarely takes into account, material sizes to be supplied to site for use. Thus, the need of a skill supervisor by the contractor would make the process more efficient on all types of project sites by keeping the workmen at the best behavior towards positive use of resources for the work.

#### Causes of Materials Waste in Construction

This is in categories and subcategories which include;

# Design Related

- Error in contract documentation.
- Choices about specifications of products.
- Contract document incomplete at commencement of construction.
- Changes to design.
- Lack of attention paid to dimensional co-ordination of products
- Designer not familiar with possibilities of different products.
- Lack of professional in document writing
- Lack of knowledge about construction.

- > Complex of detailing in drawing.
- Selection of low quality products.

#### Procurement Related

- > Ordering errors, over-ordering, under-ordering etc.
- > Lack of possibilities to order small quantities.
- > Order not complying with specification.

#### Materials Handling Related

- Damage during transportation to site/on site.
- Inappropriate storage leading to damage or deterioration.
- Unpackaged supply.
- Throwaway packaging.
- Criminal waste due to damage or theft.
- Lack of onsite materials control and waste management plan.

#### **Operational Related**

- > Errors by trades persons or labourers.
- Accidents due to negligence.
- Damage to work done due to subsequent trades.
- > Use of incorrect material thus requiring replacement.
- > Required quantity unclear due to improper planning.
- Delays in passing of information to the contractor on types and sizes of products to be used.
- Equipment malfunctioning.
- Inclement weather

A study was conducted in china to investigate the composition of construction waste and their causes. The findings showed that concrete cement, brick, timber, Tile steel and aluminum wastes are the main waste produced on construction sites and the sources at these waste are varied [19]. In another research by [20] causes of waste investigated were categorized into:-

- Lack of planning
- Unclear information
- Source quality problem
- ➢ Late information
- ➢ Lack of control
- Sources mis-used
- Problem in quality information

Design problem in many researches is known as one of waste sources. Designers think that waste arise in the course of operation on site whereas about one third of waste is through design related errors. Waste production process in design period is complicated because of many different materials used in building and many stakeholders that impact on waste production. [18] are of the view that designers and architects have an important role to play in waste minimization. Furthermore waste in construction sites can originate from one or more of the following

#### Waste Reduction Strategies in Building Construction Sites

Since waste of materials are becoming so common within the construction sites various means were identified on how to reduce or prevent construction wastes, the following method could be adopted as revealed by [21]

- Re-use of waste such as off-cuts from reinforcement bars for other minor fixing application and welding fabrication should be encouraged.
- Useful material should be sorted out instead of dumping the general waste together. This facilitates re-use.
- Standardize material should be specified and utilize to reduce waste.
- Allowance made for waste by estimators should be scrutinized to avoid excess.
- Site management techniques like proper supervision, employing skill tradesmen and tightening security loopholes would reduce waste generation on site.
- Qualified purchasing officer who is knowledgeable in the construction process and interpretation of material specification should be assigned the responsibility of ordering team.
- Operational waste generated due to the nature of construction process, fame pressure, poor craftsmanship and lack of adequate supervision could be reduced through the introduction of incentive schemes.
- Checking materials on arrival to site to ensure that quantity are according to specification. Couple with proper supervision during handling of materials would help reduce material waste in the industry.

#### Material Management Problem in Building Construction

There are many issues which contribute to poor material management in construction projects. [22] suggested that waste, transport difficulties, improper handling on site, misuse of the specification, lack of a proper work plan, inappropriate materials delivery and excessive paperwork all adversely affect materials management. Shortage of materials contributes to the cause of delay in managing materials in the construction site [23]. Late delivery of ordered materials is also problematic in materials management process. Furthermore, [24] noted that the common issues relating to materials management include: Receiving materials before they are required, causing more inventory cost and chances of deterioration in quality, not receiving materials at the time of requirement leading to loss of productivity, incorrect materials take-off from drawings and design documents, subsequent design changes, damage/loss of items.

#### Waste Management on Building Construction Sites

The practice of waste management for construction activities has been promoted with the aim of protecting the environment and the recognition that wastes from construction and demolition works contribute significantly to the polluted environment [15]. This increasing awareness of environmental impacts from construction wastes has led to the development of waste management as an important function of construction project management [15]. There are several approaches to construction waste management. The process of managing construction waste goes far beyond the disposal of the wastes itself. It is an all-encompassing strategy to effectively utilize construction resources, with the view to reducing the quantity of waste and also utilizing the generated waste in the most effective manner. The most common approach to management of construction waste is dumping in landfill sites. However, decreasing landfill space has led to increasing costs of landfill disposal to the contractor [17]. Also, a relatively large amount of materials is being wasted because of poor material control on building sites [18]. This has prompted the need for alternatives for waste prevention and the initiatives to reduce, reuse and or recycle waste produced which are referred to as the three R's (3R) of construction waste management.

According to [25] there are two fundamental reasons for reducing, reusing and recycling waste: the economic advantages, and the environmental advantages. The economic advantages include lower project costs, increased business patronage, lower risk of litigation regarding wastes amongst others while environmental advantages include the minimization of the risk of immediate and future environmental pollution and harm to human health. Past research into the causes of waste in construction project indicates that waste do arise at any stage of the construction process from inception, right through the design, construction and operation of the built facility [26]. Waste management is made difficult in the construction due to the unique nature of each project, the hostility and unpredictability of the production environment, and the intense cost and time pressure that characterize many construction projects. In reducing waste, two principles prevail: first reduce the qualities of waste generated and second adopt an effective system for managing the unavoidable waste produced. In managing the unavoidable waste, there are three options in order to reference, namely, 'refuse', 'recycle' or disposal'. The balance between the three will depend upon the nature of the materials wasted. It should be noted that waste management activities were merely another workload burden perceived to be irrelevant to contractor job. This defeatist mindset represents a psychological barrier to the adoption of positive attitudes, and indicates that waste reduction depends upon the ability of managers to install the value that operatives attach to construction materials. If perception of economic viability change, then so could attitudes. This can be achieved through measures such as

i. Education (training) programs to increase knowledge levels,

- ii. Incentives to operatives to engage in less wasteful practices, and
- iii. Development of more efficient and convenient ways of dealing with waste to make its generation less of a certainty.

## III. METHODOLOGY

The methodology was based on a survey of related works and data collected through administration of a well-structured questionnaire to a sample of population for the study. The questionnaire survey was used to elicit response on the application of construction waste management in building projects from professionals. The respondents were experienced construction project managers, site/office engineers and organizations' managers with sufficient experience. The study was carried out in Jos, Plateau state of Nigeria. The study however was limited to the stated city. Out of the fifty (50) administered questionnaire, forty (40) were returned and use for the analysis, this puts the response rate at 80% which is satisfactory as against the researches carried out by [27] with 52% and [28] with 54%. Descriptive statistics such as frequency counts; mean and standard deviations were employed in analyzing and interpreting the data collected.

#### IV. RESULT AND DISCUSSION

## Part A: General Information

Profession of the respondent.

Table 1: Profession of the Respondent

Responses	Frequency	Percent (%)
Architect	5	12.5
Builder	5	12.5
Quantity		
Surveyor	16	40
Civil Engineer	9	22.5
Other	5	12.5
Total	40	100.0

From Table 1 above the highest concentration of the respondents are quantity surveyors (40%), civil engineers (22.5%), then other professions (12.5%), while Architects and builders have (12.5%) respectively.

Part B: Material Management Practices in Nigeria Construction Firms

Responses	Frequency	Percent (%)
Bulk purchase	34	85.0
Unit purchase	6	15.0
Total	40	100.0

From the result of Table 2 it shows that 85.0% of the respondents prefer bulk purchase of materials while 15.0% prefer their purchase in units.

Table 3: Undertake market survey before ordering for materials

Responses	Frequency	Percent (%)
Yes	35	87.5
No	5	12.5
Total	40	100.0

Table 3 shows that 87.5% of the respondents agree to undertaken market survey before ordering for materials while 12.5% of the respondents disagree. However there is adequate knowledge of the material nature and quality to be purchased.

Table 4: Assessment of Materials

Responses	Frequency	Percent (%)
Testing	14	35.0
Selection	11	27.5
Measurement	8	20.0
Others	7	17.5
Total	40	100.0

From Table 4 above, 35.0% of the respondents agree that materials can be assessed by testing, 27.5% observed that materials can be assessed by selection while 20.0% agrees with measurement of materials and 17.5% agrees with other forms of assessment.

Table 5: Person in Charge of monitoring handling of Materials on Construction site

Responses	Frequency	Percent (%)
Site Engineer	17	42.5
Project		
Manager	12	30.0
Store		
Manager	11	27.5
Total	40	100.0

From Table 5 above, 42.5% of the responds agrees that site engineer are responsible for monitoring handling of materials on construction site, 30.0% attest that project manager are responsible for monitoring handling of materials on construction site, while 27.5% store manager is in charge of monitoring handling of materials on construction site.

Factors militating against effective Materials Management

Table 6: Factors militating against effective Materials Management

Factors	Ν	Minimum	Maximum	Mean	Std. Deviation	Rank
Sourcing of materials and requisition	40	1.00	5.00	4.1750	1.08338	5
Demand estimation	40	1.00	5.00	3.9500	1.23931	14
Transportation	40	2.00	5.00	3.8250	.95776	17
Receiving and verification of materials on site	40	3.00	5.00	4.3000	.79097	1
Storage of materials on site	40	1.00	5.00	4.0000	1.06217	13
Issuing of materials for use	40	1.00	5.00	3.8000	1.11401	18
Procurement for materials	40	3.00	5.00	4.1750	.81296	5
Quality inspection and control	40	2.00	5.00	3.7000	1.13680	19
Maintenance	40	3.00	5.00	4.0500	.87560	11
Time	40	1.00	5.00	3.6000	1.21529	21
Materials handling	40	1.00	5.00	4.0750	1.20655	10
Stock and waste control	40	2.00	5.00	4.2000	.82275	4
Financial ability	40	1.00	5.00	4.1000	1.03280	8
Possession of qualified staff	40	3.00	5.00	4.3000	.82275	1
Possession of qualified subcontractor	40	3.00	5.00	3.9500	.87560	14
Possession of required equipment	40	2.00	5.00	4.2250	.91952	3
Competence of estimators	40	2.00	5.00	4.0500	.81492	11
Availability of equipment	40	2.00	5.00	3.6750	1.04728	20
Duration of the project	40	1.00	5.00	3.5750	1.15220	22
Type of Project	40	2.00	5.00	3.8750	1.15886	16
Types of materials	40	2.00	5.00	4.1000	.98189	8
Level of awareness	40	3.00	5.00	4.1750	.78078	5

In the analysis of factors militating against effective material management in Jos, Plateau State, a list of factors was provided which the respondents were asked to rank based on the level of impact that they present on building projects. Result in Table 6 shows the ranking of these factors and their associated significant differences in the mean of the various identified factors across the different categories of respondents. From Table 6, the result reveals that the respondents agreed by ranking first receiving and verification of materials on site and possession of qualified staff with a mean of 4.30 respectively as a major factor militating against material waste management. The implication is that they recognize the impact of receiving and verification of materials on site and possession of qualified staff as major problem lies in the low verification of the material supply and using

unqualified staff in the supervision of the construction edifice which can adversely affect the building production process. The possession of required equipment with a mean of 4.23 is ranked third as a major factor militating against material waste management in construction; however the implication is that the equipment available in the check of material supplied and received for construction purposes are lacking.

Overall, it can be seen that 22 of the identified factors militating against material waste management have a mean value of 3.0 and above. This implies that all these factors have considerable amount of high impact on material waste management application in building projects in the study area.

Impact of Waste in Building Project

Factors	N	Minimum	Maximum	Mean	Std. Deviation	Rank
Waste consumes resources and time without adding value to the client	40	1.00	5.00	4.2750	1.08575	1
Cost of wasteful activities on building projects is invariably borne by the client	40	2.00	5.00	3.9250	1.07148	7
Wastes in building projects could lead to frustration on the part of the client	40	1.00	5.00	3.8750	1.30458	8
Cost of handling wastes affects the project overall cost	40	2.00	5.00	4.0000	1.03775	6
Disposal cost represents about 0.5% of the cost of a houses total construction cost	40	3.00	5.00	4.0250	.76753	5
Wasteful activities in building projects reduce the contractors' profit margin	40	1.00	5.00	4.1500	.94868	3
Wasteful activities in building projects could lead to liquidation	40	1.00	5.00	4.1000	.92819	4
Waste in building projects could lead to abandonment	40	1.00	5.00	3.7500	1.27601	9
Construction process wastes produce no benefits but costs to the Society	40	1.00	5.00	3.2500	1.17124	12
Construction process waste creates economic problems	40	1.00	5.00	3.7750	1.16548	10
Construction wastes creates environmental and health problems	40	2.00	5.00	4.2750	.81610	1
Waste in construction depletes non-renewable resources	40	1.00	5.00	3.6000	1.10477	11

Table 7:	Impact	of Waste	in	Building	Project

The research also attempted to find out factors which may impact of waste on building projects which were ranked according to their perceived impact on building production process by the respondents. Table 7 shows the distribution of the responses, the means, standard deviation and rank (based on mean) for each factor. From Table 7, the result reveals that the respondents agreed that waste consumes resources and time without adding value to the client and construction wastes creates environmental and health problems with a mean value of 4.28 ranked first as major impact of waste on building project, the implication is that when there is much waste consumed on site it affect the project process at the long run this however do not add value to the client in terms of performance total project cost. Also waste create nuisance in the environment in terms of creating health and environmental threat to workers and the environs. Wasteful activities in building projects reduce the contractors' profit margin ranked third with a mean of 4.15 as a major impact of waste on building projects; the implication is that waste activities will definitely result in additional procurement of construction materials which will deter the enjoinment of initial estimated profit of the contractor. Other factors also have high impact on building project as the average mean of all the factor is above 3.0. It can be deduced from the above result that waste from construction project has high impact on building project performance.

Measures for Effective Materials Management

Factors	Ν	Minimum	Maximum	Mean	Std. Deviation
Timely placing of orders for materials	40	2.00	5.00	4.5750	.78078
Ensure quality assurance/control processes are in place	40	1.00	5.00	4.3750	1.03000
Logistics for tracking & transportation of materials to site	40	1.00	5.00	3.9250	1.18511
Receiving and inspecting materials on site	40	2.00	5.00	4.2000	.88289
Storage & issuing of materials to construction location	40	1.00	5.00	4.2250	.99968
Complete quality records of materials	40	1.00	5.00	3.8500	1.33109
Established material management system to be used	40	2.00	5.00	4.1750	.87376
Documentation	40	1.00	5.00	3.8750	1.32409
Record receipt of goods upon delivery	40	1.00	5.00	4.2500	1.03155
Monitoring of materials distributed	40	2.00	5.00	4.2000	.93918
Assigning of material codes	40	3.00	5.00	4.1000	.81019
Construction activities and schedule of materials	40	2.00	5.00	4.2250	.89120
Proper materials handling	40	2.00	5.00	4.1750	1.03497
Make the store safe from theft and vandalism	40	1.00	5.00	4.3250	1.02250
Materials return to be submitted weekly	40	2.00	5.00	3.7250	.98677
Determine the daily allocation of materials on site	40	1.00	5.00	4.0500	1.21845

Table 8: Measures for Effective Materials Management

Having established the impact of waste on building project performance it is pertinent to know further the measures for effective material management. It is clear that Timely placing of orders for materials, Ensure quality assurance/control processes are in place and Making the store safe from theft and vandalism are the three major measures with mean average value of 4.578, 4.38 and 4.33 respectively for ensuring effective management of materials on construction sites. Furthermore, from the result above in Table 8 it can be deduced that all measures highlighted in the questionnaire are effective in the effective management of waste on construction site. However there should be effective materials management practices in Nigerian construction sites to give value for money for both the client and the contractor and also for the best performance of the purported structure. Good site management will make a serious attempt to overcome problems by providing better control of the site and more protection to work during the early and later stages of the contract.

#### V. CONCLUSION

Materials management processes require a transformation to improve the overall process in receiving and verification of materials on site, and possession of qualified staff will enhance more efficiency and effectiveness on the construction site. This is because late receiving and poor verification of materials on site, and possession of unqualified staff affects the overall performance of construction projects in terms of cost, time, quality and productivity. The minimization of materials wastage during the construction phases is important in order to avoid loss of profits. Also proper management of materials aids the speedy execution, gives high quality works and reduces the materials wastage. Materials management application improves the success rate of project planning and execution thus lowering the project cost. However proper materials management will benefit the firm in terms of increase profit margin, quick execution and reduce cost of the project.

# VI. RECOMMENDATION

- 1. There should be awareness programs for all construction firms on construction materials management and handling. Also formal education should be given to storekeepers and the foremen on effective materials haulage and handling systems.
- 2. The contractors should ensure effective control of materials from design to construction stage so as to adequately reduce processes that can lead to wastages in construction.
- 3. Contractor must be educated about possible cost savings from measures which successfully prevent construction waste, as well as the environmental impacts of the waste and its long-term national and global implication.
- 4. The construction firms should create a functioning section that would see to the appraisal of the plan and compliance with its provisions through capacity building and manpower development.
- 5. The federal government should come up with a policy on construction waste management which

may include introduction of heavy tipping charges on construction wastes (particularly those that can be reuse or recycled) and taxes for dumping or disposing wastes carelessly.

6. Construction companies should implements penalty against any worker for negligence in handling of any materials

#### REFERENCES

- [1] Adafin, Johnson Kayode et al. (2011): an assessment of factors affecting material stock control practice on selected construction sites in Nigeria', Continental J. Environmental Design and Management 1 (1): 22 31, Wilolud Journals, 2011.
- [2] Dahiru D.D. (2010): 'Problem of Ready-mix Concrete Production in the Construction Industry in Nigeria and its Cost Implication' West Africa Built Environment Research (WEBER) Conference, July 27-28, 2010, Accra, Ghana, pp. 445-57.
- [3] UK Green Building Council (2013): Waste UK Green Building Council. [Available at http://www.ukgbc.org/content/waste] accessed 16th/09/2015.
- [4] Wahab, A. B. and Lawal, A. F. (2011) an evaluation of waste control measures in construction industry in Nigeria. African Journal of Environmental Science and Technology, 5(3), pp. 246-254.
- [5] Enshassi, A. (1996). "*Materials control and waste on building sites*" Building Research and Information, 24(1).
- [6] Oladiran, O.J., (2008): "Materials wastage: causes and their contributions' level" Proceedings of CIB-2008, 15-17 November, Dubai.
- [7] Ammer, D.S (1980): Material management purchasing, (4<sup>th</sup> Edition). Illinois. Harvard.
- [8] Skoyles, E.R (1976): *Wastage of materials on site*. (1<sup>st</sup> edition) Butterworth, London.
- [9] Greenwood, R., Jones, P., Snow, C., & Kersey.(2003): *Construction waste minimization*-Good Practice Guide.
- [10] Khyomesh V. Patel and Chetna M. Vyas. (2011): 'Construction Materials Management on Project Sites' National Conference on Recent Trends in Engineering & Technology, B.V.M. Engineering College, V.V. Nagar, Gujarat, India. 13-14, may 2011.
- [11] Viljoen, A (2010): 'Urban .Material/waste cycles and reducing the amount of energy used.
- [12] Yahya, K., and Boussabaine, A. H., (2006): Eco-Costing of Construction Waste: Management of Environmental Quality: An International Journal Vol. 17 No. 1, pp. 6-19.
- [13] Ekanayake, L. L., Ofori, G., (2004): Building Waste Assessment Score: Design-Based Tool. Building and Environment 39, 852-861.
- [14] Farmoso, C. T. et al., (2002): Material Waste in building industry: Main Causes and prevention. Journal of Construction Engineering and Management, pp. 316-325.

- [15] Shen, L. Y, Tam, V. W, Tam, C. M, and Drew, D, (2004), "Mapping Approach for Examining Waste Management on Construction Sites", Journal of Construction Engineering and Management, Vol.130, No. 4, July/August 2004, pp. 472-481
- [16] Farmoso, C.T. et al., (1993): Developing a method for Controlling Material Waste on Building Site. Economic Evaluation and the Built Environment, CIB, Lisbon.
- [17] Lingard, H, Graham, P. and Smithers, G. (2000) 'Employee Perceptions of the Solid Waste Management System Operating in a large Australian Contracting Organization: Implications for Company Policy Implementation', Construction Management and Economics, Vol. 18, pp 383.
- [18] Poon, C.S., Yu, A.T.W., Wong, S.W., and Cheung, E. (2004): Management of construction waste in public housing projects in Hong Kong, Construction Management and Economics, 22,675-689.
- [19] Wang, J. Y., Kang, X. P., and Tam, V. W. Y. (2008): an investigation of construction wastes: an empirical study in Shenzhen, Journal of Engineering, Design and Technology, Volume 6(3).
- [20] Serpell, A., and Alarcon, L. F., (1998): Construction Process Improvement Methodology for Construction projects, International Journal of Project Management Vol. 16, No. 4 pp. 215-221, Elsveir Science Ltd and IPMA, Great Britain.
- [21] Adeagbo, D. O and Kunya S.U (2005) *Review on waste reduction strategies on Nigerian construction site*. ATBU Journal of Environmental Technology, 2 (1) 49-55.
- [22] Zakeri, M., Olomolaiye, P., Holt, G. D. and Harris, F. C. (1996): A Survey of Constraints on Iranian Construction Operatives' Productivity. Construction Management and Economics, Vol. 14, No. 5, pp. 417-426.
- [23] Aibinu, A. A. and Odeyinka, H. A. (2006): Construction Delays and Their Causative Factors in Nigeria. Journal of Construction Engineering and Management, Vol. 132, No. 7, pp. 667-677.
- [24] Dey P.K, (2001): "Re-engineering materials management: A case study on an Indian refinery, Business Process management Journal, vol.7 (5), pp. 394-408.
- [25] Coventry, S. and Guthrie, P. (1998): Waste Minimization and Recycling in Construction – Design Manual CIRIA London.
- [26] Faniran, O.O., and Caban, G. (1998) Minimizing waste on construction project sites. *Engineering, construction and Architectural Management*, 5(2), 182-188.
- [27] Odeyinka, H. A., Lowe, J., and Kaka, A., (2008). An evaluation of risk factors impacting construction cash flow forecast. Journal of Financial Management of Property and Construction, 13(1), 5-17.
- [28] Yassaims, F., Arditi, D. and Mohammadi, J. (2002). Assessing Contractor Quality Performance. Journal of Construction Management and Economic, 20(3), 211-223.