Cape Peninsula University of Technology

THE IDENTIFICATION OF NON-VALUE ADDING ACTIVITIES ASSOCIATED WITH SITE MANAGEMENT IN THE NIGERIAN CONSTRUCTION INDUSTRY

BY

DON-WILLIAM OSILUAMHE IMIMOLE

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Supervisor: Dr Ruben Ndihokubwayo
Co-Supervisor: Dr Eric Kwame Simpeh

Bellville Campus

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DECLARATION

I, Don-William Osiluamhe Imimole, student number 215180291, declare that the contents of this thesis represents my own unaided work, and that the content has not previously been submitted for academic examination towards any qualification. Furthermore, it represents my own opinions and not necessarily those of the Cape Peninsula University of Technology.

.....DonImimole..... .....11/28/2018.....

Signed **Date**

ABSTRACT

This study sought to determine the prevalence of non-value adding activities (NVAAs) associated with construction site management in Nigerian, utilising Lagos State as the case study. To pursue the study, the following objectives were formulated: (1) to identify the sources of NVAAs during construction projects; (2) to determine the causes of the occurrence of NVAAs; (3) to ascertain the effects of occurrence of NVAAs on management of personnel on construction sites; and (4) to develop techniques to mitigate the effect of NVAAs on construction projects.

Relevant literature related to the matter under investigation was extensively reviewed. An exploratory study on non-value adding activities was conducted; the findings of which determined the focus of the study. This was achieved through a qualitative method where open-ended interviews were administered to purposively selected construction professionals including construction managers, site engineers, consulting engineers, and site managers who were based in Lagos. Additionally, observations of construction activities on site also provided the basis for the primary data collection to gain an in-depth understanding of the factors contributing to the occurrence of NVAAs on site. Three construction firms partook in the survey, and a total of eight construction professionals were interviewed. It was uncovered that improper planning of construction site activities – for example material management, site layout, and the competency of site personnel – came about to non-value adding activities, thereby confirming the situation of poor site execution within the construction industry.

This exploration was limited to certain building construction locations in Lagos State, Nigeria. Accentuation was put on the evaluation of non-value adding activity (i.e. waste) related with site management in the construction industry amid the undertaking execution stage. The research was done to assist in creating a proper contribution to the perception of NVAA management measures by way of the application of significant principles that have been deserted, and also to fashion responsiveness for construction company workforces to determine factors that contribute to NVAAs with the goal that the level of waste can be decreased while simultaneously increasing productivity during construction.

Suggestions regarding the reduction of NVAAs include the following: (1) Early identification of the root causes of NVAAs would certainly provide a useful information for project stakeholders to design a suitable containment strategy to minimise / prevent the occurrences of waste; (2) Conducting workshops for project team members on a regular basis concerning lean design management principle will also assist in reducing the incidence of NVAAs on site; (3)

Accepting effectual implementation of appropriate methodology for lean construction principles at an early stage of the construction project, may minimise non-value adding activities during construction; (4) Comprehending the consequences of non-value adding activities means partakers will learn to perform their parts as facilitators in a concise, clear and comprehensive manner in order to ensure the minimisation of non-value adding activities; (5) Further study should concentrate on the complete obstacles of the consciousness of NVAAs and developing of a universal implementation framework capable of fitting into any construction setting; (6) Further study should investigate the acceptance of other lean construction tools and techniques within the Nigerian construction industry; (7) Further study should delve into and tackle the study restraints highlighted in this project, exploring issues surrounding the identification of non-value adding activities that were beyond the scope of this study.

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DEDICATION

I dedicate this thesis to God Almighty, who saw me over the hurdles of the programme, making adequate provision for my sustenance; to my parents, Mr. & Mrs. William Okhumode Imimole; to Mr. and Mrs. Oiwoh Lucky; to Falilat Abdul Rasheed Izague; and to my siblings –Abel, Fabian and Fabius Imimole – for their love, support and prayers for the duration of my study.

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LIST OF ABBREVIATIONS

GDP: Gross Domestic Product

CAGR: Compound Annual Growth Rate

CII: Construction Industry Institute

ISO: International Organisation for Standards

FMEA: Failure Mode & Effect Analysis

TQM: Total Quality Management

QIM: Quality Inspection and Management

CHAPTER 1

INTRODUCTION

1.1 Background

Activities carried out in construction industries projects in developing countries, as well as Nigeria, are poorly performed in most respects, and poorly performed activities are viewed as non-value adding activities. One significant factor adding to this obstacle is non-value adding activities (NVAAs) (Ofori, 2012:7). Non-value adding activities, known as *waste*, influence projects in negative modes. Execution has been a challenging issue in the construction procedure for a long while. The construction industry is predominantly project-based, with numerous difficulties inbuilt in the construction projects. The construction procedure includes managing the various interests of different partners and the resultant consolidating and changing on account of these interests. These alterations (variations) are considered non-value adding prevalent indicators that gravely affect both the execution and profitability viewpoints in construction projects (Ralph & Iyagba, 2012:467). Until now, there has been a high level of NVAAs related with site management Nigerian construction industry (Oladapo, 2015: 2). As a result, the quantity of waste materials not only comprises of waste materials quantity on site, but also inter-linked activities including overproduction, defects, inventories, transportation, movement, waiting time and substitution (Rahman & Wang, 2012:10).

Ohno (1988:17) also identifies a series of similar waste types (NVAAs) in terms of lean production (Ibid). Overproduction, producing defective products, inventories, motion with no value to the product, excessive waiting and extra process, are regarded as the flow of material while transportation and substitution are identified as the work of men (Ibid).

Overproduction Waste is similar to quantity production of materials more than what is required or earlier than when it is needed (Ibid). This is often caused by quality problems: when it is anticipated that several units will be lost along the production process, extra units are produced to ensure satisfaction of customers and conformance to their requirements. This kind of waste could be the overproduction of concrete / mortar that cannot be used on time, frequently resulting in material waste, underutilisation of manpower and equipment usage (Henderson, 2004:3).

Waste of rejects, known as ‘defect’ or ‘unsatisfactory work’, takes place when an end product does not conform to specifications (Ohno, 1988:17). This is the most minute form of waste produced by the construction industry, where product components may not conform to specifications (Henderson, 2004:1). Rework or adoption of irrelevant materials in the building

process might take place as a result of the defects e.g. excessive thickness of plastering. A wide range of factors such substandard design and specification, lack of planning and control, insufficient qualification of team members and lack of integration between design and production. Techniques to manage defects must be implemented and verified. In an effort to rejuvenate scrap products, new waste management processes must be adopted. New processes to manage defects must be implemented and verified (Ibid).

Waste in transportation, deals with the domestic delivery of materials on construction sites where poor working environment layout or an absence of process stream makes numerous stops and begins in a creation cycle (Rahman & Wang, 2012:11). The major reason for overabundance transportation and inordinate dealing can be due to construction site designs. In addition, the adoption of deficient equipment or dilapidated pathways can also produce this kind of waste. Every movement should have a purpose , since items that are moved incur a cost (Henderson, 2004:3). Disruptions to workflow can hugely increase transportation costs, with defects such as man hours waste, energy waste, waste of site space and the waste that is produced during transportation (Lim & Wui, 2012:13). Adequate re-laying of machines within the factory space, from a functional to cellular layout, has been demonstrated not to only help in waste reduction, but also in the reduction of work in progress and waiting time minimisation. This can also apply to the construction industry where adequate site layout plans would assist in the reduction of excess material movement (Rahman & Wang, 2012:11).

Waste of processing deals with the nature of the processing (conversion) activity, in which the material movement waste that develop in the construction process flow and add no value to the product or service from the customer's perspective (Sagoe, 2011:45). This is usually as a result of the poor quality of the work carried out. A prominent example is the a type of rework which relates to surface finishes (Rahman & Wang, 2012:11).

Waste of inventory deals with excessive or needless inventories result in material waste (i.e. deterioration, losses due to inadequate stock conditions on site, robbery, vandalism and monetary losses due to capital that is constrained) (Forbes & Ahmed, 2011:64). Overabundance of inventory is regarded as waste due to the fact that no value is added by stocking inventory. Furthermore, inventory consumes space and hold on to capital, incurs storage costs (security and insurance) and raises the risk of damage during storage, as well as the risk of obsolescence (Rahman & Wang, 2012:11).

Waste of waiting is associated with idle time as a result of lack of synchronization and material flow levelling, and levels by a variety of groups or equipment. In a situation where a product is stagnant, waste of waiting occurs (Ohno, 1988:18). Idle time may occur as a result of waiting

for any number of things: such as quality assurance reports / results, engineering, maintenance, raw materials and scheduling of equipment (Henderson, 2004:3). However, Henderson (2004:3) stressed that the integration of interrelated processes may assist in minimising / reducing *waste of waiting* significantly in construction projects.

Waste of movement, associated with ergonomics and seen in all instances of bending, stretching, walking, lifting and reaching, is concerned with any and all unnecessary movements made by workers during execution of tasks, whether caused by inadequate equipment, ineffective work methods, or poor arrangement of the working place (Forbes & Ahmed, 2011:71). Travelling longer distances within a work site to carry out assigned tasks, for example, is a waste of time and effort escalating opportunities for accidents and injuries and their associated costs. Hence, with a proper layout of construction site, the unnecessary motion of personnel can be minimised, thereby saving costs and time (Rahman & Wang, 2012:11).

This research will be limited to construction sites and will only focus on the above seven wastes as other types of waste are imbedded in one of the seven types, or they are a cause of the waste rather than a waste itself. For instance, *waste in human potential* is a cause of other types of waste such as processing waste or the waste of defects that arise from the lack of skill of workers. Apart from that, the seven wastes identified are linked between root causes, human behaviour and loss of profits.

To address the problem of NVAAs and achieve performance improvement, *lean principles* have been introduced in the construction industry. According to Forbes and Ahmed (2011:57), *lean design and construction* involves the application of lean methods and techniques to design construction processes which derive benefits that have been clearly established in manufacturing operations. Examples include lower cost, fewer delays, less uncertainty, fewer NVAAs, more efficient buildings/facilities and higher user satisfaction.

In actual fact, the reduction of NVAAs is a key lean construction principle having to do with relating one particular duty to another, or from one transaction to the other, and the form of delays and defects that may occur must be corrected (Ahmed & Forbes, 2011:447). NVAAs involves work undone, rework, unwarranted work, stoppages, errors, deterioration of materials on site, and waste of materials (Alarcon, 1997:376). According to Alwi (2002:19), these NVAAs can give rise to defects, overproduction, excessive processing, unwarranted movement of people, waiting time, inventories, change in designs, trade skills deficiency, dawdling decision making, poor coordination among colleagues, lack of foresight and planning, poor documentation on site, delays in delivery of materials, constructability problems, slow revision

of drawings, conflicting site design information and vulnerability and unpredictability in climate conditions. These causes would thus be able to be grouped with regard to documentation and design, handling of materials, ordering of materials, expert management and physical influences (Alwi, 2002:22).

It is generally known that if these NVAAs are ignored or disregarded without reasonable control measures set up, they will be in flaw with the organisation in the construction industry in terms of competitiveness (Alwi, 2002:20; Koskenvesa, 2010:482). Thus, if the most important influencing factors in any contracting organisation are identified, measures can then be applied to enhance contractor's performance (Ofori & Chan, 2001). For this reason, this research will focus specifically on site management, taking knowledge of material management, site layout and the competency of site personnel: the greater the knowledge and perception of non-value adding activities associated with site management, the higher the prospect of circumventing them and, consequently, reducing construction delivery cost.

1.2 Context of the research

In the previous two decades, there has been an increase in the rate of construction activities in Nigeria, an indication that its success is contributing greatly to the country's Gross National Product (Ralph & Iyagba, 2012:467). This increase, though, has led to concomitant waste generation at various stages of construction projects. Materials procured during construction are not fully used, for example, and leftover remnants remain as waste that is not accounted for. This waste could be either from an initial excess procurement of materials or poor material handling during the project (Wahab & Lawal, 2011:248). Osuagwu (2009:9) argues that the failure or success of construction projects may be ascertained in terms of cost of budget and completion, time taken to actualise the project, planned duration and the extent to which the completed project harmonizes with design specifications and qualities. Measuring waste by taking all eight categories of waste into consideration – that is, overproduction, waiting time, inventory, transportation, over-processing, motion, defects and workforce – is a highly effective way to assess the overall performance of a production system as it allows for identification of areas of potential improvement and identification of the main causes of inefficiency (Sagoe, 2011:14). Equally, in terms of usage of construction materials, the planning and management is based on the experience of the contractor and not on rational analysis of the work to be carried out based on the application of known specific tools and techniques. The failure of any construction project through poor material management has numerous repercussions. Since NVAAs are considered to be a contributing factor for delays, cost overrun and other related problems in construction, to successfully execute projects, efforts must be made to minimise the number of NVAAs in construction (Han, 2007:2088);

therefore, this research intends to identify NVAAs linked with site management, specifically within the Nigerian construction industry, with a view of improving construction site management practices.

1.3 Problem statement

Construction operations involve site layout planning to allow movement of people and equipment to execute works. However, wrong scheduling of construction site activities – such as managing of materials, layout of construction site, and the (in)competency of site workers – can generate non-value adding activities i.e. poor performance on construction site (Eduardo, 2002:317). The awareness of such non-value adding activities means their occurrence can be minimised.

1.4 Sub-problems

- Improper planning for construction operations related to material management process leads to the occurrence of NVAAs.
- Improper construction site layout affecting the movement of men, equipment and materials on site leads to the occurrence of NVAAs.
- The competency of site management personnel in minimising the occurrence of NVAAs associated with material management process and site layout is not evident.
- The impact of NVAAs on construction site performance with regard to time, cost and quality is not yet evident.
- It is not evident whether the mitigation strategies in place for minimising the occurrence of NVAAs on site are efficient.

1.6 Research questions

To achieve desired results from this study, the following questions are considered:

- How do NVAAs occur during management of construction projects?
- What are the causes of NVAAs on construction sites?
- What are the effects of occurrences of NVAAs on management of personnel on construction sites?
- How could the repercussions of NVAAs on construction projects be mitigated?

1.7 Aim

The aim of this study is to identify NVAAs specifically related to site management within the Nigerian construction industry.

1.8 Objectives

- To identify the sources of NVAAs during construction projects;
- To determine the causes of the occurrence of NVAAs;
- To ascertain the effects of occurrences of NVAAs on management of personnel on construction sites; and
- To develop techniques to mitigate the effects of NVAAs on construction projects.

1.9 Research hypothesis

To evaluate the reliability and to assure generalisability of study findings, the following hypotheses were formulated:

Hypothesis$_1$: There is a correlation between sources of NVAAs and internal mitigating techniques.

Hypothesis$_2$: There is no correlation between causes of NVAAs and external mitigating techniques.

An alternative hypothesis to guide in deciding about acceptance or rejection of the null hypothesis is formulated thus:

H_o: There is no correlation between the mitigation techniques for the occurrence of NVAAs and sources and causes of NVAAs.

1.10 Conceptual framework

The notion about activity that is not adding value to the course of construction differs to an extent depending on which sector that you relate to. In most production-related activities, an amazingly low percentage of the working time is used for direct work. As for the plumbers exclusively, 35-40% of the working hours are direct work, while 9-14% of the working hours are lost, such as waiting and unused time (Josephson & Saukkoriipi, 2003:7). The remaining time is used for planning and preparing the actual work. While construction workers are quickly blamed for being late to the site and taking much time on coffee breaks, it is typical to solve problems during these coffee breaks and to shift break times in relation to ongoing activity.

The major reason behind schedule delays and cost overruns in design and construction projects is construction process waste (non-value adding activities or necessary-non-value adding activities) (Han, 2007:2082). Hence, to successfully carry out design and construction projects, it is necessary to take heed to minimise wasteful activities (NVAAs) while maximising the value-adding activities (VAAs). NVAAs must be eradicated from the process, or, if not removed, they tend to thrive, to multiply and eventually to impact operational effectiveness since the availability of waste (NVAA) tends to grow rapidly by generating ancillary or secondary support wastes (Tersine, 2004:17).

In order to prepare an effective management plan for the minimisation of NVAAs, it is important to firstly identify activities that lead to waste (Han, 2007:2083). However, systematic identification of and quantification of waste is often one of the most challenging aspects of lean construction advocates. The identification of the incidence of NVAAs during the process allows construction managers to more easily identify proper solutions and apply new techniques for reducing the amount of NVAA, thereby increasing project productivity. Unfortunately, construction management often fails to identify, and perhaps even more critical, fails to address, NVAAs in construction waste due to both poor recognition of NVAAs and the dearth of appropriate tools for measuring NVAAs or VAAs. Figure 1 shows the necessity of knowing the types of waste, the sources and the detrimental effects.

After waste has been identified, construction practitioners need to evaluate the problem to discover the root causes of the problem. The danger of not identifying the root cause is that a superficial symptom of the underlying problem may be (mis)deemed as the core problem. On the other hand, by precisely identifying the actual root cause, construction practitioners will be able to select the most appropriate measures to control the waste. While it may be neither possible nor necessary for construction practitioners to implement *all* the lean techniques suggested in this study, in each of the waste categories, a few lean techniques that are appropriate and easy-to-use are presented. However, it is necessary to note that using lean practices alone is inadequate to minimise NVAAs; this must be combined with other lean philosophies and lean tools to reap beneficial improvements in project performance. Moreover, construction industry practitioners must understand clearly the underlying concept of each lean technique to obtain the best result.

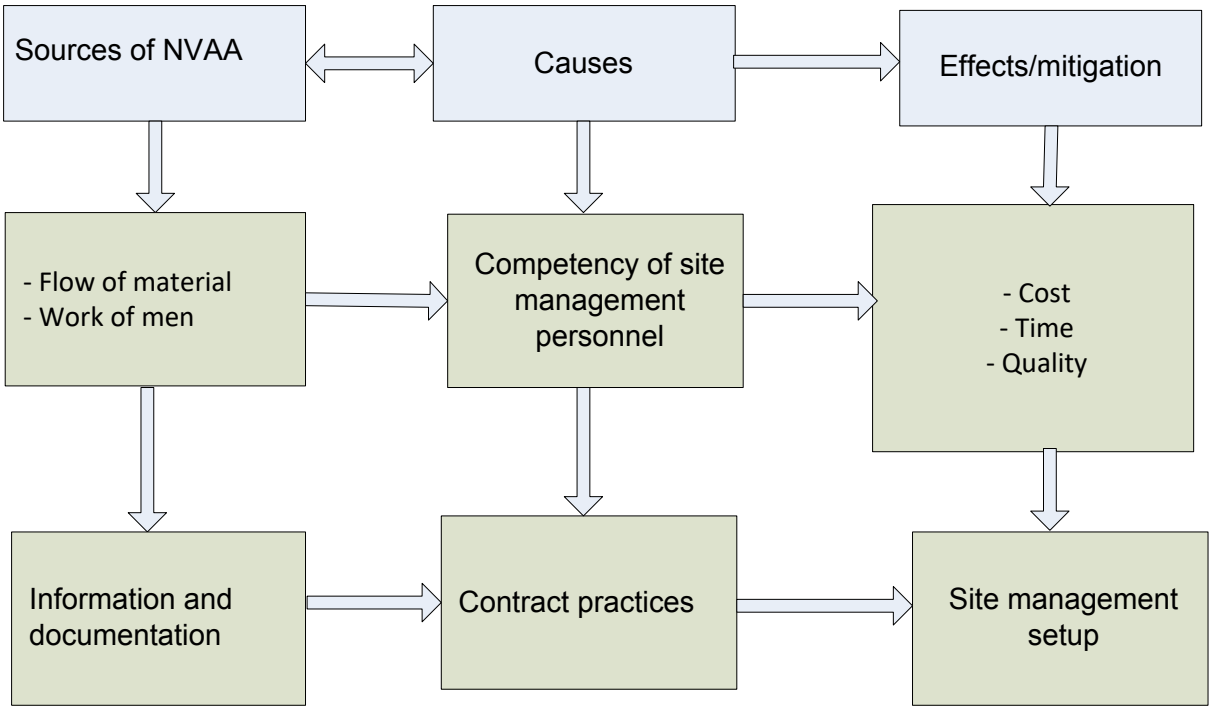

Figure 1.1: Conceptual framework

1.11 Significance

This research is of great importance to all workers, contractors, consultants (architects, builders, quantity surveyors, engineers and project managers) and clients operating within the construction industry. Hence, the study was conducted with the intent of creating suitable inputs to the understanding of NVAA management measures through the use of several significant principles that have hitherto been neglected, principles such as lean thinking which has transformed so many industries that its implementation in construction is finally allowing for the emergence of potential benefits. As the lean approach is the only way that improvements in time, cost and quality can be made simultaneously, without trade off, its application requires a fresh approach in considering the entire process – from design through to construction to waste removal – to create continuous flow that will radically enhance value to the customer (Watson, 2003:1) as well as maximise awareness for construction company workers to determine factors that influence NVAAs so that the level of waste is decreased and productivity during construction increased.

The study will also enable efficient resource allocation by encouraging the integration of network scheduling techniques with adherence to accepted standards in material planning and scheduling processes. This, then, will improve planning skills for industry participants.

This research is intended to assist construction managers in identifying the incidence of NVAAs within Nigerian constructing companies.

1.12 Limitations

1. The study was conducted in Lagos, Nigeria, with primary data collection limited to construction firms operating within Lagos, and not elsewhere or beyond.
2. The construction process covered in this study related specifically to improving site management by the reduction or even elimination of NVAAs on site during the construction work process.
3. The case studies selected for this research will concern the aspects of building construction projects related to reduction or elimination of NVAAs during the construction work stages.
4. Attention is only on the assessment of NVAAs (waste) related to site management in the construction industry during implementation of projects since the total of construction management is considerably broader in perspective.

1.13 Assumptions

- It is assumed that the proposed participant companies as case studies will be cooperative, allowing access to their sites and existing documented records as required by the study.
- It is assumed that respondents will not be biased when answering questions, as this will be of importance during the data collection process.

1.14 Key terms

Construction industry: The construction industry refers to the organized economic activities involving the assembling of materials, labour and other resources (such as money and machines) and managing all these inputs towards achieving a desired goal which usually is a permanent structure (project) to serve not only individuals, but also public interest at large in a societal group (Osuagwu, 2009:16).

Management measures: Management measures entail the overall planning, coordination, and control of the size, amount, or degree of waste by assessing its importance, effect or value (US EPA, 2005: 209).

Non-value adding activities (NVAAs): Non-value adding activities are wasted efforts that consume time and resources (manpower, materials, and machinery) without directly or indirectly adding value to project requirements or outcomes (Han, 2007:2082).

Site management: Site management refers to the management of construction activities during three phases of site development: pre-construction, construction and post-development (Parks, 2012:1).

Waste: Waste refers to all non-value adding activities (NVAAs) in the construction process (Ahmed & Forbes, 2011:53).

1.15 Ethical statement

This study will be carried out in accordance to Cape Peninsula University of Technology (CPUT) postgraduate guidelines relative to research, and other policies of the University relevant to the study, and in compliance with globally consented standards.

- The designations of the member organisations and individuals will not be recorded on research instruments, and no recompense will be giving to any respondent or participant in the study.
- Quality confirmation will be carried out with respect to correctness and completeness of questionnaires.

1.16 Chapter outline

This research is organised in six chapters:

Chapter One will introduce the entire research project, covering the background to the study, context of the research, problem statement, sub-problems, research questions, aim and objectives, research hypothesis, conceptual framework, signifance, limitations, assumptions, key terms, ethical statement, chapter outline and chapter summary.

Chapter Two presents a systematic review of pertinent literature related to the issues addressed in this research covering the Nigerian construction industry, examining the concept of NVAA (waste), the causes of NVAAs in the construction industry, sources of NVAAs, the impact of NVAAs in the construction industry, identification of construction waste, classification of construction waste, prevalence of NVAAs in the construction industry , minimization of NVAAs on construction site, NVAAs control measures recommended in previous studies and chapter summary.

Chapter Three outlines the overall methodological approach for collecting and analysing the data for the research covering the research approach and justification, methodological approaches, the sources of data, population and sampling method, questionnaire design, administration of the survey, validity of the instrument and data, data analysis for the study, limitation of the study and the chapter summary.

Chapter Four analyses the exploratory study and interviews to be administered, including the presentation and analysis of data gathered at the early stage of research covering the findings from the exploratory study, analysis of the main study, analysis of the respondents' biographical information, analysis of the characteristics of the project, frequency analysis of cost, time and size of executed building project, reliability testing, analysis on sources of NVAAs in building projects, analysis on the causes of NVAAs on building projects, descriptive analysis of effects of NVAAs on project performance, mitigating measures against the occurrence of NVAAs, hypothesis testing and assurance of the findings, discussion of findings in the context of the literature review and chapter summary.

Chapter five draws conclusions and offers useful recommendations based upon data analysis, linking them to the problem statement, aims and objective of the subject under investigation and it covers limitation, validity assurance of the quantitative research results, achieving the objectives of the research study, conclusion and recommendations.

CHAPTER 2
LITERATURE REVIEW

2.1 Introduction

This section, reviewing the literature on construction waste, with emphasis on the identification of non-value adding activities associated with site management in the Nigerian construction industry, covers the following areas: the Nigerian construction industry, examining the notion of non-value adding activities, causes of non-value adding activities in the Nigerian construction industry, sources of non-value adding activities in the Nigerian construction industry, impact/effect of non-value adding activities, identification of construction waste, prevalence of non-value adding activities in the construction industry, importance of managing non-value activities in construction and the minimisation of non-value adding activities on construction sites.

2.2 The Nigerian construction industry

Economists regard the construction industry as a principal driver of economic development in any country, particularly since virtually all other segments of the economy, somehow, depend on the products and services of the construction industry to carry out their operations. For instance, it would be unimaginable for the manufacturing industry to flourish without appropriate buildings and infrastructure, including manufacturing plants, roads linking raw materials with manufacturing plants, office buildings and many other products of the construction industry (Dantata, 2008:31). The industry exudes enormous potential, such as self-sufficiency in cement production, which on its own can lessen material challenges and huge impairments in physical infrastructure such as roads, rails, airports and sea-ports (Oluwakiyesi, 2011:9). It would be impractical for any industry to work with no infrastructure set up, or without access or connection streets for the transportation of crude materials, or without office buildings or other similar construction productivities. Clearly, then, the construction industry contributes significantly to the economy. As such, there is hope for the Nigerian construction industry in the coming years, with emphasis shifting to infrastructure growth. But the Nigerian construction industry has suffered many setbacks in terms of completion of projects by stipulated deadline within the predetermine cost. Many Nigerian construction projects reflect time and cost overrun, oftentimes leading to total abandonment of the project (Mohammed, 2012:786).

According to a Nigerian construction industry report (2001:2), Nigeria's construction industry has a percentage accountability of 1.4 of its Gross Domestic Product (GDP). Most significantly,

is the fact that regardless of the growth in the construction industry, its contribution to the country's GDP has remained low. In 1981, the construction industry made up for 5.8% of the country's GDP and in the last thirty years, has risen to approximately 495 times its GDP size. However, since 1981, the construction industry has only grown 125 times its size. Noteworthy is the fact that the country's GDP has remained the same over the years and the construction industry is yet to discover its potential, despite the country's colossal deficiency in framework. In the last three decades, production of crops, production of crude oil and wholesale and retail trade have recorded a 27-year compound annual growth rate (CAGR) of 28%, 29% and 26% respectively, in contrast, the construction industry GDP grew at a CAGR of 21% over the same period. It is evident, therefore, that Nigeria is far below realising its full potential in the construction industry (Oluwakiyesi, 2011:2).

Predominantly, the Nigerian Construction industry has a few large expatriate firms who perform about 90% of the work, while the rest of the work is carried out by small Nigerian contracting firms(Ayodele, 2013:17).These majorly concentrate on building construction, though more recently, one or two have embarked on civil engineering works. Even, during the execution of small building construction works, only a few can reach completion with expatriate firms, as local contractors have to deal with problems of working capital, poor management and lack of proper organisation (Oladapo, 2015:3).

As in every single other nation, several entities including architectural and engineering firms, general contractors and subcontractors, clients, equipment and materials suppliers, financial institutions, management and engineering consultants, labour unions and of course, the government are actively involved in the Nigerian construction industry (Dantata, 2008:35).

2.2.1 Construction industry problems in Nigeria

The Nigerian construction industry is beset with numerous problems, most of which are not necessarily unique to Nigeria, but some are more exaggerated in this country (Adewuyi: 2013:97). Some of these problems are as follows:

2.2.1.1 Unethical practices

The problem of corruption has dented the image and stifle the growth of the construction sector in Nigeria as it is detrimental to competition among participants in the industry. According to Alutu (2007:84), the most common of these unethical practices in the Nigerian construction industry are as follows: disclosure of important information to tenderers after paying bribes; addition of kickbacks in tender sum; overlooking of excessive prices by officials due to vested interests; forwarding bids having officials' interests built in; allowing multiple subcontracting of

a project, and assurance of winning bids to tenderers prior to the bidding process. While these practices are common in other countries, it is important to note that their excessive occurrence in the Nigerian construction industry is alarming (Alutu, 2007:84).

2.2.1.2 Lack of skilled manpower

Dantata (2008:61) indicates the inadequacy of skilled local manpower in Nigeria is one of the major problems the construction industry faces; and consequently, many large companies intentionally procure manpower from other places in order to fill the gaps. As a results, Dantata (2008:61) emphases that this increases the operating costs at the same time shrinks profit margins, majorly because foreigners must be paid higher salaries than local workers, and quality houses and security must be provided for foreign workers. Additional needs such as healthcare must also be taken care of at supplementary (Dantata, 2008:61).

Darren (2012:18) discusses that when demand for workers to fill a particular position is greater than the supply of available qualified personnel, skill shortage occurs (Olsen & Defnall, 2012:1). However, if supply is greater than demand, a surplus occurs (Ibid). Awe (2006:33) posits that an evidence of shortage may be shown in a particular occupation and doesn't necessarily have to sweep across the entire occupation. In addition, it may also be restricted to locations. Awe (2006:33) suggests that market might adjust overtime in several ways, price and quality adjustment inclusive and the balance clears. However, in terms of practical work an interpretation or identification of shortages is usually done directly in terms of difficulties in filling immediate vacancies.

In competitive labour markets, employers recruit candidates who possess skills that do not match the ideal. As a result, from the employers perspectives, shortages are experienced, but from the perspective of the market, if the positions were occupied, then no shortages are recorded. On the contrary, in a slack labour market, an imbalance may not occur, if over-qualified people occupy positions in a slack labour market (Bilau & Sholanke, 2015:100).

According to Medugu (2011:64) skilled labour shortages have an effect on various areas of construction activities such as time, cost and quality of work which may also hinder the attainment of financial advancement for which such projects are conceived. Presently, Nigeria is going through an economic reform and requires a competent, productive and flexible workforce to promote her economic growth. However, Dantong (2015:11) discovered that the shortage of skilled craftsmen is not relative to the shortage of workers; rather it is a shortage of properly trained, skilled and productive personnel available to work certain jobs (Dantong & Dessah, 2015:3). Attar (2012:11) identifies lack of training and retention, an overaged

workforce and an industry that doesn't consider the needs of the youth as reasons for such shortage. Furthermore, a continuous poor image of the industry has discouraged the younger generation for choosing construction as a viable profession (Ibid).

Ankrah (2007:26) identifies this as a plague in the Nigerian construction sector, which has complex implications for both businesses and the economy in general. As a result, there is an urgent need to address the issues from poor workmanship to craftsmen training (Ibid). However, various reports indicate the existence of shortages and poor quality of craftsmen in the Nigerian construction industry (Dantong, 2011:4; Long, 2013:82). The problem is further aggravated by the growth and presentation of new machineries and materials needing even advanced level skills (Awe, 2006:33; Darren, 2012:17).

2.2.1.3 Unavailability and high cost of materials

The shortage of some fundamental materials in Nigeria leads to a rise in construction cost since these materials are imported into the country. Mostly, the cost of the locally manufactured materials cost more in comparison to costs in higher countries(Patience, 2008:10).

Taking the demand for cement in Nigeria as an example, which has a very high cost compared to the quantity being manufactured locally, making the cost of cement in Nigeria relatively higher to that of other countries. In the case of steel, most of what is used in the construction industry is imported since the local steel pants lack the capability to demands of the product (Adewuyi, 2013:99). However, certain special materials- such as cement, chemicals, paints and other materials which can only be found in a few countries must be imported into Nigeria at higher costs to consumers. Overall, this is a significant issue within the Nigerian construction industry (Dantata, 2008: 69).

2.2.1.4 Unstable prices of materials

In Nigeria, there are fluctuations in the prices of construction materials such as cement and steel. For instance, in a situation where there is a problem with one of the county's cements plants, there is a significant escalation in the price of cement, further increasing the gap between the demand and supply of the product (Dantata, 2008:70). Since some contracts are awarded on a fixed-price basis, this becomes a significant issue for firms since their costs become higher than proposed cost (Dantata, 2008:70).

Omoregie and Radfort (2015:80) conducted a study on factors contributing to project delays and construction cost escalation in Nigerian construction industry. The study revealed price

variation to be the most significant factor responsible for project cost escalation (Omoregie & Radfort, 2015:80). Patience (2008:10) argues project cost escalation is attributable to the limitation in exchange rate which in turn affects construction material prices.

2.3 Examining the concept of NVAA (waste)

Non- value adding activity as used is adopted in relation to lean production (Koskela, 1992:4). The auto industry form the basis for the lean production concepts and are adapted to the environment of the civil construction. This term, an adaptation of the Toyota Production System (TPS) principles to construction, was described initially by Ibid (1992:17) who opined alteration took place in the auto industry as a result of the use of this system and considered its application in construction. Ibid(1992) explains that to implement the concepts of the lean thinking in the civil construction, an understanding of the existing concepts is necessary. The following 11 principles for flow process design and improvement are presented by Ibid (1992:22) :

I. *Minimising activities that do not add value:* this consists of reducing activities that take time, space, and resources more than required to transform material and/or information into what the customer requires but add no value.

II. *Upsurge in output value vis-à-vis customers' requirements:* According to Isato (2000:12) this principle explains that the needs of internal and external clients must be clearly identified and this information must be taken into consideration during the manufacturing and management of the product.

III. *Reduce variability:* According to Koskela (1992:17) the longer the cycle, the greater the number of activities that do not add value to the end item. A possible way of minimising variability consists of working with standardised activities.

IV. *Minimisation of cycle times:* Compressing the cycle time and ensuring the inspection reduction, move and wait time is an objective of lean thinking. Koskela (1992:26) explains that cycle time can be reduced considerably through successive processes, including eliminating the work in process, reducing the batch size, changing plant layout so that moving distances are minimised, synchronizing the flows, reducing variability, changing the order of activities from sequential to parallel, and isolating the main value adding sequence from support work.

V. *Simplify by minimising the number of steps and parts:* Simplification is a reduction of the number of components in a product or the reduction of number of steps in a material or

information (Koskela,1997:29). This can be done by excluding activities that add no value from the production process, by combining parts or steps that add value.

VI. *Increase output flexibility:* Increase of output flexibility seems to be contradictory to simplification, nevertheless, many firms have succeeded in achieving both goals simultaneously. Isato (2000:14) opines that process concept, as well as value-adding, are synonymous to increase on the output flexibility and refers to the possibility to modify the output characteristics without substantially increasing the cost of the product.

VII. *Increase process transparency:* According to Koskela (1992:18), it is the easy detection of errors in the production system. Hence, proper planning ensures team productivity will be adequately evaluated.

VIII. *Focus control on the complete process:* A team member must be responsible for the complete control of the process at it is very important. However, the complexity of the project may require involvement of the entire productive chain as opposed to just the company. Long term relationships with suppliers and team building have been established to obtain mutual benefits for inter-organisational flows (Koskela, 1992:27).

IX. *Build continuous improvement into the process:* Koskela (1992:19) suggests the effort made to achieve waste minimisation and value maximisation of the product should be a continuous internal, incremental and repetitive activity. An analysis of the divergence in each party of the process is important.

X. *Balancing conversion improvement with flow improvement:* Koskela (1992) suggests the improvement in activities flow possesses great potential for minimising non-value adding activities in construction operations. Ibid (1992) further postulates that the larger the complexity of the production process, the higher the improvement in the flow of activities, the better the results.

XI. *Benchmark:* The benchmarking process does not only deal with simulation for better performance, but also a process that contributes to the company growth, because it prompts the company to obtain data and analyse its processes as well as that of top market leaders.

Non-value adding activity is used to differentiate amid physical construction waste on site and other waste which happens during the course of construction (Alwi, 2002:2). Alarcon (1994:378) and Koskela (1992:17) argued that every one of those activities that create cost, whether direct or indirect, and take time and resources, or require storage but do not add value

or progress to the product are labelled as *non-value-adding activities* or *waste*. Waste in the construction industry has been the theme of much research around the globe as of late, some of which has concentrated on the detrimental effect of material waste on the environment (Formoso & Hirota, 1999:326). Nonetheless Serpell (1995:69) postulates that construction project managers are not aware of, or do not recognise the factors contributing to waste. For this reason, Serpell and Venturi (1995:69) maintain that identifying NVAAs associated with site management, as well as classifying them according their level of importance would provide the basis for management to design appropriate mechanism to minimise its occurrence and effect on project performance.

Formoso (1999:328) opine that waste is "any losses produced by activities that generate direct or indirect costs but do not add any value to the product from the point of view of the client". According to Formoso and Hirota (1999:329), NVAAs during construction is not only attributed to the quantity of material wastage on site, but also relates to less tangible activities including handling of materials, idle time, processing, overproduction, inventories, movement of site personnel and any other type of waste due to theft and vandalism, as well as inclement weather and accidents. Mohanty and Deshmukh (1999:165) state that, "any non-value adding activity carried out in any work system at any time can be defined as waste". Mohanty and Deshmukh (1999:165) further posit that "any resources deployed in the work process which do not create utility for the stakeholders can be regarded as waste". Various authors (e.g Alarcon, 1995:401; Koskela, 1992:47; Lee, 1999:64) have categorised waste emanating from construction process into seven main groups namely double handling of materials, poor material allocation, material waste, waiting, defects, delays, and rework/repairs. A study by Serpell and Venturi (1995:11) to identify the causes of NVAAs in the Chilean building construction industry revealed that travelling time, idle time, and waiting time were the significant factors contributing to waste on site. In another study, Mohamed and Ticker (1996:379) revealed that 25% time savings is achievable in a typical construction work package without increasing allocated resources, findings which are primarily associated with time waste on construction sites.

2.4 The causes of non-value adding activities in construction industry

Han (2007:208) explains that generally errors and changes cause interruption, loss of productivity and rework which requires additional amount of time and loss to compensate for. Although a situated model can be used to identify and quantify NVAAs through the rework cycle, they can also be easily can be identified and quantified by the use of a simulated model, they can also be easily disseminated into other inter-related activities (Han, 2007:2088). There is usually a spread on the construction site during the design stage in form of the rework cycle

irrespective of the project type, the location and activities to be performed (Cooper, 2002:215). Hwang (2009:197) also identified design error as a significant factor contributing to rework among other sources such as amendment to design, owner change, constructor error/omission, change at the request of the constructor, vendor error/omission, vendor change, and transportation error, on both owner and contractor report projects on the database of the Construction Industry Institute (CII) in the USA.

Nazech (2008:4) further indicates that the causes of NVAAs (waste) can be classified into six main groups as follows:

2.4.1 Manpower

Poor manpower occurs as a result of unskilled labour, inadequate supervision, sub-standard subcontractor personnel, and inexperienced site supervisors. The majority of the manpower involved in construction projects, including building construction, are unskilled, a condition which has led to inefficiency and reworks, thereby producing waste (Nazech, 2008:5). Though Nigeria is endowed with ample manpower, the situation in the building construction sector is at best ironic. Whereas the industry is the utmost employer of the nation's manpower after agriculture, it still faces lacks of technically skilled craftsmen, a situation which affects productivity, work quality, project duration and overall organisational profit (Bilau & Sholanke, 2015:98).

Nigerian labour is utilized broadly by both expatriate and indigenous construction organizations, despite the fact that the business is capital concentrated (Chukwudi & Tobechukwu, 2014:12). By European standard, the yield of work on building and civil engineering sites is low. Work compensation are generally low and for civil engineering projects, the general labour cost is little in connection to the aggregate yield. One intriguing point to note is that expatriate contractors dependably show signs of improvement efficiency out of Nigerian specialists, ascribable to better supervision (Oladapo, 2015:142).

2.4.2 Professional management

Professional management, caused by inadequate planning, late dissemination / channelling of information, improper coordination amongst project participants, slowness in making decisions, improper planning and scheduling, and inadequate coordination between project participants, occurs because of poor professional roles, a key cause of NVAAs (Alwi & Mohamed, 2012:10). Inadequate professional management aggravate waste generation on construction site, as less attention paid to workers during material handling on site engenders waste. This problem is attributed to poor planning skills by the management on site (Nagapan

& Rahman, 2016:6). The project managers need to allocate a committed director at the site, as an inept administrator or potentially venture supervisor prompt poor workmanship and uncalled for material handling by workers. Legitimate arranging is the key administrative capacity to most viably kill these wastages (Nagapan & Rahman, 2016:6).

Professional management, in general, entails several duties such as site investigation prior to kick-off of a construction process, procurement management and material delivery, proper site records keeping, maintaining open and clear communication channels as well as high level information flow, monitoring performance on a regular basis, establishing a strong co-ordination system between different role-players, and implementing good site layout planning (Emad, 2011:1).

According to Oladapo (2015:143), the most shared criticism against Nigerian contractors is the inability to complete construction projects on time, with most problems to this end arising from deplorable orchestrating and inefficient organisation. Contrarily, the efficient organisation and utilisation of manpower and machinery may certainly lead to good project performance in term of cost, time, and job quality. There is a notion that labour is cheap, hence, the more manpower deployed on site without the proper supervision would otherwise enhance productivity. However, Oladapo (2015:143) argued that this practice engenders waste because when one talks of *cheap labour*, it is in relation to labour costs elsewhere.

2.4.3 Design and documentation

Poor design means a site documentation framework that is not very much incorporated, with ambiguous specifications, low quality drawings, delays in revision and redistribution of construction drawings, design changes and low quality design. Frequent design changes are one of the principals contributors for waste generation: waste emerges amid development because of the progressions made by the clients at the verge of project completion, or amid the advancement of the project (Nagapan, 2011: 10). At the point when the main outline drawing is affirmed by the client, the contractual worker starts the construction works at site; while construction work is in advance, any sudden change in necessity by the client will convolute the about finished work and unavoidably result in rework. The assembled structure may be demolished and re-built by the prerequisite of the new plan drawing. This issue for the main contributor is the large amount of physical waste, such as concrete, bricks, blocks and steel bar (Nagapan, 2012:11). Moreover, frequent amendments to design also leads to the generation of non-physical waste. For instance, whenever variations occur during the post construction phase, a significant amount of time is needed to rework the structure. The contractor and the client must discuss again to finalise the design drawing. Meanwhile, worker

energy, material cost, and time will all end up as waste. Hence, more attention should be focused on waste reduction during the design phase of a project in order to overcome this problem. More so, all parties involved in any construction projects should maintain open and clear communication channels with clients to avoid drastic last minutes modifications (Garas & Gammal, 2001:5; Zhao & Chua, 2003:3).

2.4.4 Material handling

Wrong material storages and poor material handling is a key cause of waste creation. The cases of wrong material stockpiling for physical waste generation are forceful handling of blocks and bricks amid construction, bringing about breaks and ruin. Aside from this, waste likewise occurs because of an improper assurance technique amid materials stockpiling (Tam & Wang, 2007:3). For instance, cement wrongly stored under a scaffold or put away in an open space enable the materials to be presented to dampness and rain. Without proper storage, the materials too will wind up as physical waste (Tam & Wang, 2007:4). Cement spoils at site because of bad storage by laborers prompt deficiency of material during construction. Deficient supply of construction materials will prompt stoppage of construction works at site. At that point materials should be reordered, making longer waiting time get new materials from providers. The manpower of waiting workers during supply of materials, and payment of hourly wage, always end up as non-physical waste resulting in NVAAs (Nagapan & Rahman, 2012:6).

Appropriate handling of materials is reliant on plaining, on clear and continuous access from the place of capacity to the place of use, inclusive of the provision of temporary roads, excessive stock is liable to damage, weakening, burglary and vandalism (Patel & Vyas, 2011:4). Disturbance of planned activity can be caused by utility administrations neglecting to fit in with program; specifically, the deferring of external services, in this way influencing material conveyance, level dispersion of materials and the situating of raising plants for vertical transportation (Muhwezi & Chamuriho, 2012:19).

2.4.5 Work and execution

Work and execution waste is produced by improper construction methods, deficiency of construction equipment, an inappropriate selection of plant, unstable equipment and improper site layout. Unskilled laborers tend to commit more errors due to both their lack of skills and poor working attitude. For instance, most workers fail to read the blueprint or drawing, so worker mistakes inevitably contribute to NVAAs (Bossink & Brouwers, 1996:55). Mistakes, for instance, during concreting works inevitably cause rework. These improper works need to be

restored and are time consuming. Besides that, mistaken handling of equipment can cause damage as this contributes to a sudden halt of work and a consequent overrun of project cost. Thus, worker mistakes can generate countless NVAAs (Nagapan & Rahman, 2012:7).

2.4.6 External factors

The impact of climate as an external factor is a standout amongst the most overpowering and significant factor leading to construction waste. Considerable rain from strong storms destroys numerous construction materials on site, for example, broken formwork, wet cement weakened and steel bars rusting. Other than that, a bursting sun with high temperatures additionally makes issues: for instance, wet cement solidifies rapidly before use which can result up physical waste on site. Aside from that, the impact of climate is likewise the principle patron for non-physical waste in circumstances where the climate or environmental change cause delays in construction works. Site works, for example, cementing and removal work, can be disturbed because of overwhelming precipitation and storms. Many construction projects have to be postponed to a later stage due to this unpredictable and uncontrollable factor (Nagapan & Rahman, 2012:7).

2.4.7 Site layout/planning

Construction site design includes distinguishing, measuring, and raising impermanent offices inside the limits of construction site. These impermanent offices extend from straightforward set down regions to warehouses, creation shops, upkeep shops, and batch plant and living arrangement facilities. Required temporary facilities and their territories rely upon numerous factors including project types, scale, design, location, and organization of construction work (Emad, 2011:1). Site planning has been the most disregarded viewpoint in the construction industry, as the attitude of engineers has been that the site will be arranged as the project progress. In any case, it is important to understand that the site planning will represent the conditions that site staff will live with for the total span of the construction time frame. In this way, careful pre-planning is basic. Likewise, since the work cost on an extensive project constitutes roughly 50 to 60% of the total project cost, significant reserve funds can happen if the work drive moves openly and rapidly inside the site (Emad, 2011:1). According to Emad (2011:2), NVAAs occurs as result of improper planning of the site; inability to design the site plan is a prime explanation behind operational wastefulness, generously increasing the general cost of a project. Without a correct site design, the accompanying issues may happen:

a) *Material stacks inappropriately located.* Materials being conveyed to site are off-loaded to an assumed correct location. This situation may lead to multiple handling of materials to another area (Emad, 2012). For instance:

- The materials might be off-loaded over a waste/supply pipe or close to the edge of excavations;
- Stacking of materials far away from the work territory;
- Materials obstructing the smooth stream of work movement during site operations, and
- Wrong delivery time as materials may not be required until some other time in the project.

b) *Plant and equipment situated in a wrong location.* For example:

- Delivery of materials cannot be executed due to inaccessibility of mixer;
- Insufficient space for aggregates storage, and
- Hoists are improperly sited in relation to the floor layout.

c) *Inadequate space allowed.* Where inadequate space exists for materials stacking.:

- Materials may be arranged to high or on the motorways causing road hazards may be; or
- There might be congestion of working areas; or
- There might have to be allocation of additional areas which may waste time due to travel time.

d) *Wrong location of site sheds in relation to their effective use.* Examples include:

- Location of site office close to noisy and dusty areas with insufficient overview of the site; and
- Warehouses being to jam-packed causing limited access for loading and offloading (Emad, 2011).

Site layout planning is a very crucial task. Large projects with high manpower, subcontractors and equipment could result in huge time loss and cost overruns, if there is no proper site planning strategy in place(Emad, 2011:1). Detailed planning of the location and layout of the site could enhance the managements effort to make considerable improvement due to minimal travel and waiting time, increasing the morale of workers and promoting a healthier and safer work environment (Emad, 2011:1).

2.4.8 Contract practice

The approach to awarding contracts could influence poor contract practices. Projects are usually awarded to the lowest bidder (Mansfield & Doran, 1994:19). Most bidders do not take into consideration contract plans, cost control, overall site management and lack management skills. Irrespective of the obvious deficiencies in the potentials for delivery, contracts are

usually awarded to politicians in Nigeria (Patience, 2008:17). Frimpong (2003:321) explains that several contractors in Sub-Saharan Africa are mainly interested in making profits and don't take management seriously. As a result, contractors tend to submit very low bids and have very little ability to effectively plan and coordinate contracts.

2.4.9 Procurement

Ordering and non-delivery

Interruption of pre-planned flow of materials may be caused by significant ordering of excess materials which can lead to redundancy of deliveries and additional handling which leads to cost overruns. Due to untrained personnel to take up duties of accurate measurement of materials on site, a huge amount of waste could arise (Muhwezi & Chamuriho, 2012:13).

2.5 Sources of NVAAs

The root causes of NVAAs can be classified in terms of design and documentation, physical factors, professional management, individuals, material, and site task (Alwi, 2002:7). Skoyles and Skoyles (1987:14) contend that construction firms are not concerned about the waste of materials since there is a perception that its occurrence is unavoidable and not significant in quantity. Construction professionals are aware of the facts but do little to determine, and eradicate, the causes, also accepting its incidence as a normal characteristic of the project.
Sources of NVAAs associated with people incorporate deficient trade skills, poor dispersion of work, late supervision of work, lack of skilled supervisors/foremen, inadequate subcontractor skills, and inexperienced reviewers. This has become a norm in the construction industry in Nigeria. Sources of NVAAs with regard to *professional management* include improper planning and scheduling, poor information management, slow decision-making process, and lack of coordination within the construction supply chain (Skoyles, 1987:17). Sources of NVAAs regarding *design and documentation* include poor quality site documentation, unclear and conflicting specifications, unclear construction drawings, slow response to requests for information, frequent modifications of design, and poor design. With regard to *materials,* the sources of NVAAs include non-conformance to quality standards, late delivery of materials, poor handling of materials, and unseemly utilization of material. What's more, the sources of NVAAs connected to site activity incorporate poor site design, obsolete equipment, equipment shortage, wrong construction techniques, and unnecessary dependence on extra time to execute work timely. Origin of NVAAs in construction as far as material or time can be categorised in respect to design, acquisition, material handling, site task, and other construction related exercises (Gul & Glenn, 2004:9).

2.5.1 Flow of materials

Aziz and Hafez (2013:683) indicate that the flow of materials is concerned with the inward movement of materials on site. In fact, Aziz and Hafez (2013:683) emphasise that unnecessary handling and utilization of inadequate materials as well as terrible states of driveways may cause this sort of waste that exacerbates the occurrence of NVAAs. It is normally identified with poor site layout and the absence of planning of material streams, with the primary results as follows: misuse of worker hours, misuse of energy, waste of space on site, and the likelihood of material waste amid transportation (Aziz & Hafez, 2013:683).

2.5.2 Work of men – labour

Labour is part of, but distinct from, other resources, because it has specific characteristics. The production output of man is a function of skill and motivation (Olomolaiye, 1988:20). Olomolaiye (1987:317) revealed that extensive investigations have been conducted in developing countries with respect to poor labour productivity, with problems being clearly identified. Indonesia, for example, has similar problems: majority of the Indonesian construction labour force are self-employed, and usually farmers from rural areas. They are often recruited through friends or relatives (typically the foremen), and are low skilled, earn low wages, and are unsurprisingly less productive (Kaming, 1997:85).

Broadly, labour productivity is negatively affected by external and internal factors, representing those outside the control of the firm's management and those originating from within the firm, respectively (Chigara & Moyo, 2014: 59). Empirical evidence is as study undertaken in Gaza strip to examine 45 factors negatively influencing labour productivity in the construction industry. Enshassi (2007:246) revealed that the 10 most significant factors negatively influencing labour productivity in construction include: shortages of materials on site; lack of skilled labour; lack of labour surveillance; misunderstanding between superintendents and labour; amendments to drawings and specification during site activities; delay in payments; working seven days per week without holiday; labour disloyalty; inspection delay, and shortages of equipment and or tools (Enshassi & Mohamed, 2007:246).

2.5.3 Design and planning

As design and planning are identified as major characteristics of the process of lean construction, any lack of knowledge regarding the significance of these could lead to disastrous loss of time, cost and overall process (Johansen & Walter, 2007:24). Due to traditional contractual procedures, design and implementation of design are treated as separate products (Rooke & Koskela, 2007:11), resulting in conflict border between the two

phases and creating waste such as incomplete and inaccurate designs, rework in design and construction, lack of buildable designs, final products with significant variation from values specified in the design, and disruption to contractors due to design changes made by designers (Rooke & Koskela, 2007:10).

According to Kaming (1997:81), it is expected that construction related to civil engineering designing and building projects will experience minor changes in volume, nature, and order or length of work to be done, after the commencement of the contract. The magnitude of these progressions depend on a few factors, not minimum essential of which are the thoroughness of the pre-outline site examination; the fulfilment of working drawings accessible at the time of estimate or proposition; and flighty conditions during construction. Design changes unavoidably prompt variety in original cost/time programs (Kaming, 1997:85).

2.6 The impact of non-value adding activities in construction industry

In different ways, NVAAs detrimentally affect construction project (Alwi, 2002:9). In terms of rework impact, NVAAs contribute most significantly to cost increase in construction projects (Hwang, 2009:197). Horman and Kenly (2005:59) struggled in opposition that as much as 49.6% of construction operative time may be dedicated to NVAAs. Overtime that appears to be a standard rather exception in the construction industry negatively impacts productivity and increases fatigue and accidents that eventually increase the cost and time spent on construction projects (Hanna, 2005:734). Leaving these NVAAs unchecked will escalate the already severe consequences for the competitiveness of organisations and by extension, the productivity of the industry (Alwi, 2002:12; Koskenvesa, 2010:484).

2.6.1 Impact on cost

Reasons for cost overrun have been usually identified as follows: unpredictable weather conditions; inaccurate materials estimates; upsurge in materials cost due to inflation; project complexity; a contractor's non-familiarity with local regulations; a contractor's lack of project type experience, and a lack of geographical experience by the contractor (Kaming, 1997:84). Dajadian and Koch (2014:92) were of the opinion that different types of waste are generated as a result of the various types of activities on construction projects causing the projects millions of dollars every year, which if managed properly or minimised, could actually save construction contractors a tremendous amount of money and be more profitable for firms. According to DETR (2000 cited in Andrew, 2004:14), "25% of waste produced on construction sites could be minimised relatively easily, which could increase profits by up to 20%". Increased cost of the project has a direct link with construction NVAAs. At the point when materials arrive at site, they are to be recorded, nonetheless without a appropriate logging

system for the assignment of materials to specific uses within the work, large quantities of waste are being produced. Because of this, the cost of raw material required for projects increases, while the cost required for handling, storage, transportation and disposal, including landfill tax, also increases. All these factors are simultaneously responsible for increasing the cost of the entire project (Sawant, 2016:203).

2.6.2 Impact on time

As for work flow processes, it has been found that construction work flow consists of a multitude of non-value adding activities consuming a high percentage of overall working time (Augustine, 2011:43). In all estimations presented from the research compiled by Koskela (1999:244), the average working time spent on value-adding activities amounted to between 30% to 40%. For instance, the average working time spent on 17 observed building projects surveyed in Chile, conducted by Serpell (1995) from 1990 to 1994, showed that the minimum value of productive work was 35% and the maximum was 55%.

A project might be deferred to a limited extent or whole because of an apparently interminable rundown of factors: intemperate climate condition; incorrectness of material assessments; erroneous expectation of skilled workers production output (particularly in developing nations, where output are yet to be institutionalize); inaccurate prediction of equipment production rates; material shortages; equipment shortages; skill shortages; location project restrictions; inadequate planning; poor labour productivity; and even design changes (Kaming, 1997:82). While some of these factors may lead to late project completion, others may have little to no effect on construction time. Nonetheless, all delays during construction projects usually cost money (Kaming, 1997:84).

2.6.3 Quality

Quality is a measure of employees' affective responses to working and living within organisational systems. Often, management focus is on ensuring that employees are satisfied, safe, and secure and so forth, so as to work in conformance with specifications (Aziz & Hafez, 2013:684). Quality is a management technique which involves all the processes required to decide the quality arrangement, goals and obligations to meet the expectations of the stakeholders (PMBOK, 2008:189). A project might be finished on time and within estimated cost, however unless it accomplishes the predefined quality or execution criteria, it will be a mistake or even an altogether disappointment. Prominent building failures, for example, Priory Hall just serve to fortify the general population concern communicated in the Egan Report's discoveries that 30% of structures neglect to meet the desires of their proprietors. Such failures might be restrictively costly to correct, unsafe and can demolish reputations overnight (Cunningham, 2013:13).

The frequent occurrence of NVAAs during site activities can be costly for both contractors and clients of constructed facilities. In fact, the cost of construction associated with rectifying defective components detected late during construction has been estimated to be between 6% to 15%, while 5% of construction cost is wasted due to rework of defective components detected during maintenance (Boukamp, 2006:3). A further 54% of construction waste may be ascribed to human factors such as insufficient supervision of construction work and unskilled workers on site. In addition, 12% of construction defects are associated with material and system failures (Boukamp, 2006:6). Since the main cause of NVAAs are uncontrollable, Waje and Patil (2013:16) emphasised the need to improve the inspection and assessment of the quality of construction projects in order to minimise the occurrence of NVAAs.

Because of the effort to promote quality management to oppose NVAAs, the International Organisation for Standards (ISO), founded in 1947 in Geneva, Switzerland, was advocated and certified for management standardisation. The ISO has since been accepted internationally for quality production legislation (King & Terlaak, 2006:32) because it endorsed the adoption of Total Quality Management (TQM), Six Sigma, Failure Mode & Effect Analysis (FMEA) and Quality Inspection and Management (QIM) as approaches for quality building production. Nonetheless, top quality in project delivery can be achievable through the implementation of: quality planning; quality policies and procedures; quality assurance, and quality control as stressed by Knutson (2009:506). Hence, the ability to satisfy the stated and implied needs of a customer is determined by the characteristic quality of the product (PMBOK, 2008:190).

2.6.4 Professionals/workmen involved in the project

Human attitude has been identified as one of the significant factors negatively influencing the implementation of lean construction techniques in various construction firms (Howell, 1999). Based on studies by Alinaitwe (2009), Mossman (2009), Forbes and Ahmed (2004), Common (2000), Alarcon (2002), and Castka (2004), several of these factors include: poor understanding of client's brief; misconceptions with regard to lean practice; lack of transparency; cultural change; lack of teamwork and team spirit; lack of self-criticism; lack of cooperation; poor housekeeping; poor leadership and conflicting leadership style; over-enthusiasm; seen as too complex and alien, and fear of unfamiliar practices (Bashir, 2010:5). Inappropriate construction methods may lead to rework, concomitantly affecting worker morale through exhaustion and stress, which thusly engenders poor perfection in the construction process (Emuze, 2011:141).

2.7 Identification of construction waste

Seneratne and Wijesiri (2008:36) stipulate that when a method for minimising the existing waste on construction sites is proposed, construction industry stakeholders must know exactly what waste is, and its forms of occurrence. Paliari (1999:26) refers *construction waste* as all resources consumed not meeting an anticipated value standard. Freitas (1995:9) adds that *construction waste* can be defined as every resource that is spent in excess, further than the strictly necessary, to deliver a service. The waste in construction can originate from different causes and situations, as follows:

2.7.1 The physical waste

Physical waste is defined as loss of materials, damages that cannot be repaired, materials that cannot be used or losses during construction activities that arise from construction, renovation and demolition activities, including land excavation or formation, civil and building construction, site clearance, demolition activities, roadwork and building renovation (Kofoworola & Gheewala, 2009:731).

2.7.2 The non-physical waste

Non-physical wastes are related to cost overrun and delay in construction projects (Nagapan, 2012:22), interpreted as intangible losses of money and time as opposed to physical wastes. In the context of this study, the focus is on non-physical waste only. The prevalence of non-physical waste is normally evident during the construction process. In contrast with material waste, non-physical wastes are the intangible time lost and cost overruns associated with a construction project. The waste is also considered as any inefficiency that results in the use of equipment, materials, labour and money in the construction process (Nazech, 2008:3). In other words, overproduction, waiting time, material handling, inventories and unnecessary movement of workers are all considered as waste (Formoso & Hirota, 1999:329).

2.8 Classification of construction wastes

Nazech (2006:8) maintained that waste can be categorised according to its origin, which is the stage to which the main root cause is related, such as during the production stage. It can also be originated by processes that precede production, including material manufacturing, training of human resources, design, material supply, and pre-planning (Nazech, 2006:8). The categorisation of construction waste according to its origin may lead to the identification and understanding of different forms of waste in order to development / design effective containment strategies to avoid or minimise its occurrence (Nazech, 2008:2).

2.8.1 Seven waste classification

According to Formoso (1999:328), waste can be categorised according to Shingo's seven wastes, as follows:

2.8.1.1 Overproduction

Formoso and Hirota (1999a:328) described *overproduction* as the quantity produced greater than required resulting in material wastage, man hours and or machinery usage. It usually produces inventories of unfinished products or even their total loss, as in the case of materials that can deteriorate. A cited example of this type of waste is the excessive production of concrete or mortar that cannot be used on time (Formoso & Hirota, 1999a:328).

2.8.1.2 Substitution

Substitution is monetary waste as a result of substituting a material with a more expensive one. A typical example is the use of highly sophisticated plant / equipment where a much simpler one could be useable, or the execution of simple tasks by an over-qualified worker (Formoso & Hirota, 1999b:328).

2.8.1.3 Waiting time

Formoso and Hirota (1999b:328) described *waiting time* as the lack of synchronization and levelling of material flows, and pace of work by different groups or various equipment uses resulting in idle time. A typical example that results in idle time is the shortage of materials or lack of work space available for a gang which includes waiting periods, stoppages, clarifications, variation in information, rework, ineffective work, delays in planned activities and abnormal wear of equipment (Formoso & Hirota, 1999b:328; Dajadian & Koch, 2014:92).

2.8.1.4 Transportation

Transportation is concerned with the internal movement of material on site. This kind of waste is as a result of the use of inadequate equipment, the lack of planning of material flows, excessive handling of materials, bad conditions of pathways, improper site planning arrangements, and poor site layout. Its main consequences are waste of man hours, waste of energy, waste of space on site, and the possibility of material waste during transportation (Rahman & Wang, 2012:11).

2.8.1.5 Processing

Processing is allied to the nature of the processing (conversion) activity, which could only be shunned by altering the construction technology. For example, a proportion of mortar is usually wasted during ceiling or wall plastering (Meghani & Hingu, 2013:30). In construction, this type of waste arises as a result of over-design, unnecessary processing steps, low efficiency machines, inadequately sized machines and over-factoring (Mahamid & Elbadawi, 2014:1313).

2.8.1.6 Inventories

Rahman and Wang (2012:11) defined *inventories* as wastage of materials and monetary losses caused by unnecessary or excessive inventories. According to Rahman and Wang (2012:11), this incidence may arise as a result of lack of resource planning or uncertainty of estimation of quantities. Examples of material wastage due to inventories include losses due to inadequate stock conditions on site, robbery, deterioration, and vandalism, while monetary losses may be due to a capital that is tied up.

2.8.1.7 Movement

Movement is concerned with unnecessary or inefficient movements made by personnel during their job operations, possibly caused by incorrect location of plant/equipment, ineffective work methods, or poor arrangement of the working place (Formoso, 1999:329).

2.8.1.8 Production of defective products

The production of defective products arises when a ultimate or transitional product does not stick to the quality specifications (Formoso, 1999:328). This could result to rework or to the incorporation of unnecessary materials to the building (indirect waste), for instance the undue thickness of coating. Defective products can be instigated by a wide range of reasons: poor design and specification, lack of planning and control, poor qualification of the team work, and lack of integration between design and production (Formoso, 1999:329).

2.8.1.9 Others

Other waste is waste of any nature different from the previous ones, such as burglary, vandalism, inclement weather or accidents, for example (Formoso, 1999:329). The detrimental effect of weather is an important factor in an external group of wastes. Weather, in fact, is the most influential factor causing delay waste. Some of the site works, such as concreting and excavation works, must stop due to heavy rains and storms, as these severe

weather conditions consume much time and cause delays (Nagapan & Rahman, 2012:5). For construction projects, time plays an important element. Much construction must reschedule their site works due to this problem. Weather or climate change, though, are factors which cannot be controlled by humans; these are natural effects. Thus, the waste due to weather can only be intelligently managed with good decision making and astute management skills (Adewuyi & Otali, 2013:747).

2.8.2 Waste according to the type of resources consumed

Castelo (2007:13) categorised construction waste into two categories: physical and financial waste. The classification encompasses the following:

2.8.2.1 Physical waste of materials

Physical waste of materials consists of added materials relative to the original amount of material quoted for in the project. Foo and Rahman (2013:1) carried out a three month observation on site to identify the various types of physical waste generated on site, with five main types of physical waste emerging:

- **Concrete waste:** This is generated due to mishandling of construction components like concrete piles which arise because of leftover and unused mixed concrete during construction.

- **Timber waste:** Timber is used in construction for formwork and can only be used for a maximum of three times before it is disposed. The disposal, if not done properly, will lead to waste, thereby negatively impacting the environment.

- **Steel waste:** Steel, for reinforcement in construction, is one of the important materials used in construction. The waste occurs at the site due to improper cut-off of bars by inexperienced site workers; the unused parts generate waste which can be harmful to workers if not proper managed.

- **Brick waste:** Bricks and blocks are major components of buildings used for walls. This type of waste, common on site, is generated from improper handling of the materials during construction.

- **Packaging waste:** This kind of waste is generated on site during delivery process. Many suppliers deliver construction material to a site with proper packaging procedures; however, after materials are used or delivered, packaging waste remains on site. The wastes usually detected are wrapping plastic and paper (Foo, 2013: 1).

Generally, this kind of waste leads to over-processing as it results as soon as a product is made in superior quantities than required (Foo & Rahman, 2013:3). The underlying drivers of over-processing incorporate poor comprehension of the client's actual requirements, the inability to impart client necessities to laborers, or neglecting to outline the results of a procedure to adjust to customer prerequisites. Regular cases of this are over-produced reports/designs (too long, too elaborate), copying additional people than necessary on correspondence, distributing information that isn't read, and creating services or rules that aren't needed or heeded (Kavanagh & Krings, 2011:23).

2.8.2.2 Physical waste of man hours

Man hours increase delays because of arrival of materials and overproduction. Waiting is the inactive time invented when workers wait for invoices, copiers, parts, materials, machines, information from colleague, or any kind of help. Wait time translates into downtime when manpower and machinery are not engendering value (Ahiakwo, 2014:18). Some of the potential causes of waiting include unbalanced workload among employees, too few office machines, lack of a clear process, quality problems at steps earlier in the process, or waiting for a signature of approval. Solutions to excessive wait time depend on the root cause (Koskela, 1994:11).

To illustrate, Bloomington had an issue with overabundance wait time for clerks who needed direction that required an exemption to the standard procedure. One special case is the requirement for a payment plan (Kavanagh & Krings, 2011:20), the core problem was that a payment plan, along with many other exemptions, needed authorization from a designated person in a different department and building, but the designated approver had numerous other job responsibilities, resulting in delays and excessive waiting by the cashiers (and customers). To address this problem, the Bloomington group proposed a two-tier solution, the first is developing a clearer written parameters and procedures for exceptional cases, and the second is to empower the most experienced cashiers to handle many of these situations as they occurred (Kavanagh & Krings, 2011:22).

2.8.3 Waste according to its nature

According to Skoyles (1987:19), waste can be categorised according to its nature, namely natural waste, indirect waste and consequential waste. Skoyles (1987:19) contended that waste is, to a large extent, considered as acceptable on construction sites as this is generally perceived as a permanent feature during construction projects. According to Skoyles (1987:19), this type (acceptable) of waste is referred to as *natural waste*.

According to Formoso and Hirota (1999:330) and Andrade (1999:12), there is a clear distinction between *direct* and *indirect waste.* Andrade (1999:12) stated that *direct waste* emanates from materials damaged as a result of performing site activities. According to Andrade (1999:12), this kind of waste, not reusable, occurs in different forms including: waste by delivery; waste due to overproduction; waste emanating from supply and internal transportion; waste during execution of tasks; waste by replacement, and waste originating from other teams due to poor relationship on the stages of execution. On the other hand, *indirect waste* to Formoso and Hirota (1999:330) is a scenario whereby materials are not usually lost physically, however the payment for part or whole of the value is lost. This is the preventable waste as it involves the actual loss. The *indirect waste* is characterized by materials that are used in excess in the project, examples include: waste by substitution; waste by over-allocation, and waste by negligence on the part of the contractor.

2.8.4 Waste according to its control

Waste can also be categorised in two groups by considering the possibility of controlling or decreasing the index of waste detected, namely: avoidable or unavoidable (Paliari, 1999:31). According to Santos (1996:6), the *avoidable waste* is associated with the inappropriate / inadequate use of resources which subsequently affects the quality of a project. On the contrary, the *unavoidable waste* is that type of waste whereby reduction is economically viable because the cost of waste is significantly higher than the preventive cost. Generally, this waste category represents an acceptable level of waste since most of the factors are beyond the control of the contractor, depending on the complexity and nature of each firm.

2.9 Prevalence of NVAAs in the construction industry

Love (1996:17) indicates that industry researchers and practitioners acknowledge the fact that there are numerous NVAAs during the design and construction process, which absorbs time and effort without adding value for the client. Serpell and Venturi (1995:68) add that from the early stage of a construction project, construction managers must address the many factors that are likely to negatively influence the construction process, generating different types of waste. According to Formoso (1999:328), waste should be perceived as any deficiency on the part of built environment professionals that results in the inefficient use of resources such as material, manpower, machinery, and capital during the construction production process.

Researchers Alarcon (1993:57), Koskela (1992:34) and Serpell (1995:4) were of the opinion that waste emanating from construction activities include unnecessary transportation trips and long distances, idle times, lack of safety on site, quality costs, rework, improper selection of

management team, methods or equipment, and constructability problems. Koskela (1992:26) suggests the adoption of indirect or partial measures by construction project participants as an alternative way of measuring the quantity of waste in production costs, some examples of this techniques (indirect or partial measures) include identifying the defects rates, the rate of accidents on site, the cycle time process and the consequence of schedule delay. Therefore, waste must be viewed as any losses produced by activities that generate tangible or intangible costs, but do not add any value to the product from the point of view of the client. Koskela (1992:26) maintains that there is a possibility for construction practitioners to take process time for granted considering their tight and busy project schedule in the construction industry. Nonetheless, a realistic interpretation of waste is imperative on a daily basis based on daily record keeping and physical site observations to assist in counteracting the prevalence of NVAAs in construction project. There is a tendency for construction managers to overlook the root cause of waste or address waste in the construction process (Kaming 1997:82). Lee (1999:63) argued that the lack thereof or absence of appropriate tools for quantifying waste is one of the reasons why the identification of waste has been overlooked. A study in the Chilean construction industry revealed that the prevalence of NVAAs is as a result of waiting time, idle time and travelling time (Serpell & Venturi, 1995:70). Additionally, problems related to unskilled labourers were identified in the Sri Lankan construction industry.

In another study, Jayawardane and Gunawardena (1998:521) indicate that over 50% of the workforce recruited for a construction project were unskilled workers. Furthermore, Kaming (1997:83) identified lack of material, rework/repair, and lack of equipment and supervision delays as other factors negatively affecting productivity in the Indonesian construction industry. It is worth noting that the Nigerian construction industry has similar productivity issues as Indonesia. Alwi (2001:2) revealed that construction supervision is one of the major factors responsible for the prevalence of NVAAs in the Indonesian construction industry.

2.10 Importance of managing NVAAs in construction industry

The causes of NVAAs mentioned above may serve as the reason why the optimisation of construction processes concentrate on the eradication of NVAAs and unnecessary addition of cost activities that include the following: variation orders for errors / omissions in design such as rework which arise due to inappropriate planning and operation; misunderstanding within the supply chain during construction; the unavoidable inefficiencies associated with lack of skilled artisans; and concerns regarding ineffective planning and implementation of projects (Flyvbjerg & Skamris, 2004:8). Lengthening of project implementation phase due to delays may also have a detrimental effect on project objectives and performance. The inability to achieve project objectives may stem from project delays, cost overruns, accidents, non-

achievement of quality, and even disputes between parties involved in the project (Iyer & Joshi, 2008:175). A study conducted in Vietnam, a developing Asian country, was carried out on 62 construction related problems with the intention of categorising and identifying the most significant problems with respect to their substantial impact on the achievability of project objectives (Long & Ogunlana, 2004:556). The findings revealed that inaccurate time estimating, slow site clearance, excessive variation orders, severe overtime, bureaucracy, obsolete technology and equipment, improper planning and scheduling, poor site management, impractical design, and the selection of incompetent project teams were the most significant factors negatively affecting the achievability of project objectives (Long & Ogunlana, 2004:557).

Construction management literature is populated with an excess of problems associated with the construction process, to the point that failure to attempt redress through a multi-dimensional perspective may not augur well for the construction industry and academia (Emuze, 2011:94). Hence, efforts of researchers, particularly the lean construction researchers, must be applauded in terms of performance improvement through the elimination of NVAAs (Emuze, 2011:94). For instance, Kraemer (2007:130) contended that approximately 48% of all conference papers presented at the IGLC annual conferences addressed issues surrounding value adding and non-value adding activities in construction (Kraemer, 2007:130). While recognising the strides made by lean construction experts / researches, it is worth noting that NVAAs in construction project still occurs unabatedly due to it complex nature and characteristics (Han, 2007:2088). For this reason, managing NVAAs during the construction process requires a holistic approach by designing a containment strategy that will address the problem holistically rather than individual processes/organisations involved in project objective realisation (Han, 2007:2088; Senge, 2006:69). Hence, to be able to improve project performance and eliminate NVAAs, learning must recognise good performance in the past, and implement a systematic and continuous improvement plan in going forward (Cooper, 2002:213).

2.10.1 Quality management issues

Quality management as defined by Zairi (1991:41), is “that aspect of the overall management function that determines and implements the quality policy and as such, is the responsibility of the top management”. *Quality management* talks about exercises of the general management function that decide the quality strategy, objectives and duties, and the usage of these by means, such as quality planning, quality control, quality assurance and quality improvement within the quality system (Zairi, 1991:42). Love and Li (2000:489) express that if the construction industry is to enhance its performance, all associations engaged with the

project supply chain should actualize quality management practices. Quality is the product or service fitness for a customer's intended use. Applying this understanding, if a worker does not retain a deep understanding of precisely what a customer wishes to accomplish, then producing a high-quality product with no defects will be virtually impossible (Kavanagh & Krings, 2011:19).

2.11 Minimisation of NVAAs on construction site

Keys and Austin (2000:5) refer to w*aste minimisation* as any system which avoids, disposes of or diminishes waste at its source. It is imperative to promote any practice that minimise waste within construction project processes. Given that the construction industry in general has a large number of specialised areas and disciplines, many based on reoccurring processes (Alinaitwe, 2009:16); Dunlop and Smith (2004:55) propose that the identifying wasteful activities through the application of lean construction techniques may lead to a better way of minimising NVAAs and an improvement in the overall project performance. In addition, Koskela (1999:244) emphasises that the elimination of non-value adding time is achievable by compressing the cycle time to improve project performance – including inspection time, wait time and move time – as only 'process time' is when value addition takes place.

A detailed waste minimisation strategy comprising of careful planning throughout the design, implementation and occupancy phases, to ensure its success, effectiveness and compliance with building regulations may assist in monitoring and managing the different waste streams during construction. According to Augustine (2011:17), the ideal way in dealing with NVAAs is waste prevention; and this can be done through the tracking down possible waste streams at an early stage in the construction process, then plan for their minimisation. Augustine (2011:17) further states that effective communication amongst construction stakeholders to ensure exact calculations for materials required for projects may translate into prevented waste. Another best method of managing and minimising waste is through reuse, either on the existing site or a nearby site. Many materials can be usefully reclaimed, and even sold to offset the costs of a construction project.

Recycling materials is the final option for managing waste. But to facilitate this, materials that can be salvaged or recycled need to be identified early during the construction process, and separated for easy storage, collection and transfer (Augustine, 2011:62). Waste minimisation is presently no longer an alternative however a need, and recycling has been distinguished as truly outstanding, and recycling has been identified as one of the best options to convert waste materials into recycled contents (Bernama, 2006:8). Nizam and Yusoff (2010:2) stressed that wastages during construction not only affect the profit margins of contactors and inflate

construction cost for developers / clients, but also have a detrimental effect on our environment. As concerns grow over the amount of waste generated in the construction industry, recycling has been hailed as one of the most feasible ways to overcome construction wastes. This has become a best practice as many countries, including developed and developing countries, have started to aggressively recycle construction materials as this has many benefits. In some instance, up to 90% waste emanating from construction activities is recyclable (Nizam & Yusoff, 2010:2).

Recycling of construction materials can be characterized as the detachment and reusing of recoverable waste materials created amid construction and redesigning. Debris arising from demolition works, packaging, new material scraps, and old materials all constitute potentially recoverable materials. In refurbishment works, appliances, stone work materials, doors and windows are on the whole recyclable (Bernama, 2006:8). Recycling is unquestionably an inexpensively feasible option. In fact, by recycling construction wastes, contractors can recover their losses and even make a sound benefit. With recycling, the waste materials won't be dumped aimlessly, sent to incinerators, burnt on construction site or sent to landfill destinations. Quite simply, contractual workers could simply send the materials to recycling centre (Nizam & Yusoff, 2010:5).

For a successful minimisation of waste, there is a need to educate the public, businesses, developers, contractors, and architects on the viability of using less and still achieving success. Because a better understanding of the negative impact that waste has on project performance and the environment, as well as the positive impact derived from preventing waste may assist construction participants to act more proactively in their efforts to minimise NVAAs. Hence, architects must think ecologically about design and should design to use less (Construction & Demolition Waste Management Guide, 2012:6).

2.12 NVAAs control measures recommended in previous studies

In the construction industry, NVAAs are related directly with construction management as in appropriate management can lead to an increase in waste and a decrease in productivity. However, adequate attention and extra time is spent on labour and plant control by companies (Castelo, 2007:18). Evidences show that losses as a result of materials are usually higher than those due to any other factors. As a result, significant attention to materials will have a huge impact on profit increase. Harris and McCaffer (2001:17) suggest some methods that should be applied in the control of materials:

- Recruit a qualified storekeeper, with administrative experience and possessing store control skills;
- Effective material record keeping system, either manually or using computer system;
- Double sign delivery notes, particularly for ready-mixed concrete;
- Proper site layout with adequate storage space and room for movement;
- Delivery of materials packed in pallets;
- Thoroughly check deliveries against the delivery notes during the offloading of materials;
- Implement just-in-time ordering and guarantee that the materials will be delivered on site when required;
- Arrange proper material sizes to minimise cutting, and appropriate quantity to avoid excess;
- Thorough inspection of materials as they arrive on site to minimise losses due poor packaging;
- Avoid multiple handling of materials;
- Easy identification of reusable pieces;
- Have an intelligently located storage area so the operators can draw materials away from transitory areas to avoid damage, and
- Appropriate protection measures for the different kinds of materials during storage and stacking.

2.13 Chapter summary

This chapter reviewed literature concerning non-value adding activities (NVAAs) and their implications for project performance. Non-value adding activities can potentially occur on all construction projects. They occur due to several reasons that include manpower, work execution, site layout, site management, and both external and internal factors. Four sources of NVAAs were identified, namely flow of material, work of men, information and documentation. The impact of NVAAs was identified, including its impact on cost, quality, time and professionals/workmen involved in the project. The identification of construction waste posing as NVAAs were classified using the seven-waste classification, waste according to the types of resources consumed and waste according to nature.

The prevalence of non-value adding activities in the construction industry adversely impact the performance of construction projects, for example, by contributing to cost and time overrun. The frequent occurrence of NVAAs affects the overall quality of work if not carefully identified and monitored and eradicated. Hence, the importance of managing and minimising

non-value adding activities on the construction site is clear, and the recommended control measures from previous studies were identified.

CHAPTER 3
METHODOLOGY

3.1 Introduction

This section presents the approach adopted in addressing the objectives of the research. Sections to be covered include research approach and justification, methodological approaches, the sources of data, the population and sampling method, population and sampling method, questionnaire design, administration of the survey, validity of the instrument, and data, data analysis, limitations, of the study, and chapter summary.

3.2 Research approach and justification

3.2.1 Inductive approach

The inductive approach to research is the most frequently used approach in nearly all scientific research as it involves the process which begins with a specific observation or survey and thereafter general conclusions are derived from results (Walliman, 2012:159). The inductive research approach, as compared to the deductive approach, contributes to a positive result about a theory. The validity of the conclusions is reliant on the strength of the supporting evidences (i.e. the stronger the supporting evidence, the more likely the conclusions are proven valid) (Mouton, 1996; Walliman, 2005:158). However, Walliman, (2005:158) further stated that an inductive (generalized) result can only be regarded as legit if it satisfies the following conditions for an inductive research approach:.

- A large size of population for survey or observation is required;
- The observation/survey must be coordinated repeatedly under different conditions;
- The derived observed empirical data must correspond with the generalized result.

3.2.2 Deductive approach

The deductive approach to research was first orchestrated by the Ancient Greeks, and later modified by Aristotle using deductive syllogisms (Walliman, 2012:173). A deductive approach to research is comprised of logical arguments which begin with general statements with the aim of reaching a specific conclusion (Walliman, 2005:158). According to Dahlberg and McCaig (2010:20), deductive research approach involves the process of generating hypotheses from a general truth or statement to reach a definite conclusion. The results

reached in deductive research are obtained by testing these hypotheses empirically (Dahlberg & McCaig, 2010:20). Hence, the principles of this research approach can be adapted in qualitative research (Bryman, 2012:271).

3.2.3 Inductive/deductive approach

The inductive/deductive approach is a combination of observatory reasoning and logical argument in research, involving the process of developing and testing hypotheses to form a foundation for potent additional knowledge, mostly scientifically based (Walliman, 2012:158). This derived knowledge, after testing, can either be accepted or rejected based on the aim of the research. The application of this combined approach to research denotes the process of seeking valid statements (truth) from opposite school of thoughts (Walliman, 2005:159). Henn (2009) identified that in scientific research, researchers can be required to begin the research process with an inductive exploratory approach to generate hypotheses, which will be then tested using the deductive explanatory approach to reach a valid conclusion. Thus, it adopts the principles of quantitative and qualitative methodology for research.

3.3 Methodological approaches

The aim of this research is to identify non-value adding activities associated with site management in the Nigerian construction industry by exploring companies in Lagos, Nigeria, as a case study. Considering that different kinds of data was needed and to be obtained from different sources, a mixed method approach was found appropriate for the study. In line with this methodological approach, research tools associated with both quantitative and qualitative approaches are combined for data collection.

Mixed method research involves the adoption of philosophical assumptions in the collection and analysis of both quantitative and qualitative data in a single research work (Creswell & Clark 2007:9). In addition, implementation of this combined state of qualitative and quantitative provides a better understanding of the research focus (Creswell & Clark 2007:9). The mixed research approach offers the researcher an opportunity to increase the validity of the research where one method compensates for the lapses of the other, leaving no room for personal bias (Henn & Weinstein, 2006:221). Thus, mixed method enhances the integration of a variety of pragmatic and theoretical perspectives, which has been a challenge for qualitative and quantitative methods separately. The merits of integrating the qualitative and quantitative method, as postulated by Creswell and Clark (2007:9), are as follows:

I. The mixed method approach for research provides solutions to questions the qualitative or quantitative approaches separately cannot answer unaided.

II. The mixed method research provides the researcher a broader and more comprehensive perspective on the area of study.
III. The mixed method researcher is encouraged to utilise various paradigms associated with both research methods (qualitative and quantitative method).

Conversely, despite the advantages of mixed method research, researchers are faced with some challenges during their research, challenges which, according to Creswell and Clark (2011:8), include the following:

I. Process of collecting and analysing multiple data is time and resource consuming.
II. It complicates the process of data collection in research.
III. It requires multidisciplinary and specialised team work for data interpretation.
IV. Sampling size involves the design and data collection.

The mixed method approach comprises the use of interviews, questionnaires, field observation and documentary analysis. The choice of mixed method approach was decided upon for several reasons, the first being its ability to attain the logic of triangulation (Krause & Denzin, 1989:13) in view of the fact that no individual method can completely capture all the relevant features of the study. For this reason, the combination of qualitative and quantitative techniques lets a perfect validation of data gathered by distinct methods, as a result verifying the results of the study as both valid and credible. Bryman (2004:131) posits that "combining different methodologies in a single study enhances the researcher's claim for the validity of the conclusions if they can be shown to provide mutual confirmation".

Secondly, the justification for the use of both quantitative and qualitative methods in this study is because it allows for better and broader understanding and exploration of the research questions from a variety of perspectives and issues connected with non-value adding activities associated with site management in the context of the Nigerian construction industry. Bryman (2004:131) argued that while quantitative research is concerned with the perspective of the researcher, qualitative research is associated with seeking the perception of the object being studied. Hence, the combination of qualitative and quantitative methods in this study will ensure for the issues relating to the evaluation of NVAAs associated with site management in the Nigerian construction context to be captured from the perspectives of key stakeholders in the construction sector.

Furthermore, adopting different approaches to data collection and analysis ensures obtaining in-depth information from the different categories of participants, including construction companies, clients of the service, and public institutions involved in site management in one

way or another. Neglecting the mixed methodological approach, depending on single approach to data collection could mean the loss of valuable information.

3.3.1 Qualitative method

The qualitative approach, relating to positivism, seems to gather factual data useful for obtaining insight and understanding of people's perceptions of the world. For this reason, the beliefs, understanding, opinions, and various views of people are investigated (Fellows & Liu, 2003:29). Qualitative methods of research consist of: theoretical studies; descriptive research; developmental studies such as case studies and surveys, and correlation studies (Leedy & Ormrod, 2005:94). Remarkably, the qualitative research methodology is an 'umbrella term' which houses and shows the relationship between ranges of research paradigms (Nieuwenhuis, 2007:47), paradigms which include ontology, epistemology, nomothetic, positivism and ethnography (Nieuwenhuis, 2007:76). Qualitative research is usually a descriptive narration and data is collected through, field notes, memos, personal documents, questionnaires, internet materials, charts, maps, tables, diagrams and other official records (Neutens & Rubinson, 2014:131). In the context of this research, documents as a source of information include drawings, programmes of work, bills of quantities, site meeting minutes and correspondence.

In this study, qualitative methods seek to obtain the perception of construction industry stakeholders relative to site management issues contributing to non-value adding activities. Observations are to be done on specific construction sites. Qualitative research has the following characteristics:

3.3.3.1 Natural setting of qualitative research

The qualitative technique tends to relate to positivism, seems to collect accurate data, and is used to obtain insight and understanding of people's perceptions of the world. The beliefs, understanding, opinions, and views of people are investigated (Fellows & Liu, 2003:29).

3.3.3.2 Qualitative data as a process rather than outcome

Qualitative research seeks to understand the situation of a case undergoing investigation through interactions with site personnel involved in the execution and administration of the site work. This method of research deals with processes rather than outcomes, however the researchers concerns is associated with the history of the situation being investigated. Areas of concentration are questions related to the decision making process in the context of the situation under investigation (Neutens & Rubinson, 2014:132).

3.3.3.3 Qualitative data analysed inductively

Qualitative research data is analysed inductively, not collected to prove or disapprove a prior hypothesis, but rather it is first collected and then grouped together (Neutens & Rubinson, 2014:132). Open-ended questions are formulated to extract the opinions from relevant stakeholders in the construction industry, including contractors, architects and foremen.

3.3.3.4 Meaning is essential for qualitative research

For a qualitative approach, meaning is of essence. The investigation seeks to know personal experience of participants or the opinions from the experts into the field; this is called *participant perspective*. For example, investigators might ask what experts in a certain situation take for granted and then go further to look for common ground (Neutens & Rubinson, 2014:132). Experts include top management personnel from construction firms who are knowledgeable with regard to issues relating to NVAAs.

Table 3.1: Summary of characteristics of qualitative and quantitative research

	QUANTITATIVE	QUALITATIVE
Aim	This approach is aimed at counting things to explain what is observed	Detailed description of what is observed
Purpose	Generalisability, prediction, causal explanations	Contextualization, elucidation, and understanding perspectives
Tools	Numerical data collected via a questionnaire survey	Data gathering instrument could be structured or semi-structured interview protocol
Data collection	Structured approach	Unstructured approach
Output	Data presentation is in the form of numbers, tables, pie charts and histograms	Data representation is in the form of words, pictures or objects
Sample	Comprise of many respondents representing the population of interest; could be purposively or randomly selected participants	Normally a small number of non-representative cases. A case may be selected purposively based on availability, and its complexity
Objective/subjective	Objective – seeks precise measurement and analysis	Subjective - individuals' interpretations of events is important
Researcher role	Researcher tends to remain objectively disconnected from the subject matter	Researcher tends to become subjectively immersed in the subject matter
Analysis	Descriptive and inferential statistics	Interpretative

Adopted from Macdonald & Headlam (2008:9)

3.3.3.4 Justification of qualitative research

The reason of this phase was to identify site management related issues influencing the occurrence of NVAAs in the construction industry in Nigeria using three building construction firms as case studies. A *case study* is an empirical inquiry that investigates a contemporary

phenomenon in great depth and within its real-life context, especially when the boundaries between phenomenon and context are not clear. In order words, a case study is a process or record of research in which detailed consideration is given to the development of a person, group, or situation over a period of time (Yin, 2009:12).

The reason for selecting Lagos as a case study is because of the voluminous nature of building projects which have been, and continue to be done on a regular basis.

The purposive sampling method was used to select participating companies because it was assumed their construction sites would reveal the matter under investigation. A mixed method approach, consisting of semi-structured interviews and field observations, was taken into consideration for several reasons. The first reason is to be able to achieve the logic of triangulation (Krause & Denzin, 1989:13) since no method (e.g. questionnaire, interviewing or documentary analysis) can completely capture all the relevant features of the study. Hence, the combination of methods allows a proper crosscheck of data gathered by different methods, thus enhancing the credibility and validity of research results. According to Bryman (2004:131), combining different methodologies in a single study enhances the researcher's claim for the validity of conclusions if mutual confirmation can be demonstrated (Bryman, 2004:131). Semi-structured interviews (qualitative method) were adopted purposely to enable the researcher to identify NVAAs associated with site management in the Lagos, Nigeria, construction industry (Rose, 2008:7). With regard to the semi-structured interviews, the interviewer compiled a list of issues to be addressed and questions to be answered. However, as the interviews are semi-structured, the interviewer is prepared for flexibility in terms of the order in which the topics are considered, and perhaps even more significantly, prepared to let the interviewee develop ideas and speak more widely on the issues raised by the researcher. The answers are open-ended, and there is more emphasis on the interviewee elaborating points of interest. In an exploratory study by means of semi-structured interviews, Rose (2008:7) sought to understand the perception of building project participants in response to identification of NVAAs on constriction sites as part of the overall construction project process.

3.3.2 Quantitative methods

The quantitative methods focus attention on measurements and amount (i.e. more and/or less, often and/or seldom, larger and/or smaller, similar and/or different) of the characteristics displayed by the respondents and events that the researcher studies. The quantitative researcher seek explanations and predictions that will generalise to other persons and places

(Thomas, 2003:240). In the context of the study, quantitative data include quantifying apparent waste and categorisation of variation.

Quantitative research is essentially the measurement of quantities, amounts and numbers (Kothari, 2004:30). It is also a systematic process of adopting numerical information from a selected population sample group to generalise findings to the population of study (Maree & Pieterson, 2007). Similarly, Walliman (2005:302) postulates that quantitative adopts syntax mathematical operations for investigation of data properties and can be descriptive or experimental. However, this method adopts statistical method of analysis and presents results numerically (O'Leary, 2010:188). According to Thomas (2003:2), a generalizable and predictable result can be obtained from a large population with a short duration at minimum cost. This is corroborated by Flick (2011) and Maree and Pieterson (2007) who highlighted that the quantitative research method is characterised by three elements, namely objectivity, numerical results / data, and generalizability.

Quantitative research method is a research procedure that is goal-oriented and postulates inter-subjective realities as quality assurance standard (Kromre, 2006:91). Consequently, the collection of quantitative data most times involves the use of a close-ended questionnaire or checklist (Creswell & Clark 2007:363).

3.4 The sources of data

Two sets of data were identified as being relevant to the effective conduct of this research, namely primary and secondary. The primary data, referring to field data, were obtained using well-structured questionnaires developed from the initial identification of non-value adding activities associated with site management in the Nigerian construction industry. The data collection instrument was designed to elicit information regarding the following:

(a) Role of the survey participants in construction;

(b) The professional background of respondents; and

(c) The length of time the respondent has been in construction.

Secondary data, through the review of pertinent literatures, were also used during carrying out of the research.

3.4.1 Primary data collection

The primary data are the most valid information obtained in research (Leedy & Ormrod, 2010:89). The primary data entails the collection of information directly from a survey sample by a researcher. Thus, researchers are required to design the questions in clear and easily understandable formats to obtain appropriate information from the respondents (Kumar, 2011:139). The primary data for this study were collected through the administration of quantitative questionnaires to survey respondents and through interviews conducted face-to-face; the questionnaires were administered to respondents by hand and via the internet (survey monkey).

3.4.2 Secondary data

Secondary data are basically referred to as the literature review in a research. The secondary data is an overview study of data generated and findings concluded by other researchers. Struwig and Stead (2007:18) noted that secondary data are readily accessible data obtained from research works conducted by other researchers. Similarly, Dahlberg and McCaig (2010:21) explained that the review of literature enables a researcher to have an in-depth knowledge of information pertaining to the subject of the study. The secondary data collection for this study, then, was obtained from the reviews of past literature. Melville and Goddard (2004:32) further state that secondary data (literature review) is obtainable in two distinct forms: preliminary review and a comprehensive review of previous research. The preliminary review was presented in Chapter One of this study to develop a framework for the study, while the comprehensive review of literature was presented in Chapter Two of this study to evaluate and magnify the views of other researchers on relevant topics. In addition, O'Leary (2010:88) highlighted that for new knowledge to be generated, it is essential to consult past innovations. The sources of information for the review of literature for this study included textbooks, journals, articles, conference proceedings, dissertations and theses (O'Leary, 2010:88).

3.5 Population and sampling method

3.5.1 Population

Population is defined as the total unit of a particular class or group from which a sample is selected (O'Leary, 2010:102). A *population* can also be defined as a collection of people, items or animals considered for a research study (Bryman 2004:87). For this study, the population considered are workers in the building construction industry (architects, quantity surveyors, engineers, construction managers and project managers) and contractors in the Nigerian

construction industry, specifically in Lagos. Considering the large size of the population, a sampling technique was used to select respondents for the study.

Flick (2011:71) explained that the sample of any population in research is a minimised depiction of the fuller population. However, for result validity and generalisability in qualitative research, it is assumed that the larger the sample size, the better the possibility of achieving the aim of the research in an unbiased manner (O'Leary, 2010:103). The construction professionals and contractors that constitute the research sample as earlier stated, directly or indirectly contribute to factors that influence NVAAs on construction sites. Therefore, the study sample is unarguably a suitable representation of construction stakeholders in Nigeria.

3.5.2 Sampling method

Sampling theory is the process of developing ways of obtaining scientific samples (Maree & Pieterson, 2007:172). Maree and Pieterson (2007:172) stated that sampling is the process of making random selections from a population to derive a generalised finding of the whole population. O'Leary (2010:104) further described sampling as the process of breaking a large group of respondents into sections with the purpose of deriving results concerning the large group. When conducting sampling, it is necessary to note that how well the sample represents a population is dependent on the sampling design, sample size and sample frame (Floyd & Fowler, 2009; Leedy & Ormrod, 2010:144).

Considering the complex nature of the construction industry in terms of operations, management, and geographical distribution, projects professionals have been observed to operate on an extremely busy schedule. As a result, construction professionals and contractors in Lagos, Nigeria, were selected as samples for the larger research population. The samples were selected by the use cluster sampling and purposive sampling technique.

Biggam (2008:88) and Maree and Pieterson (2007:158) define *cluster sampling* as a process of redistributing a target population into smaller groups (clusters), from which samples are randomly selected for data collection and result generalisation. The common aim of adopting this sampling technique is to reduce the total number of the target population, and the cost while still maintaining the accuracy of the desired results. Noteworthy, the cluster sampling technique in data collection is most effective if the clusters formed are heterogeneous in nature as a representative of the population. The questionnaires were administered to construction professionals in Lagos, Nigeria, as earlier stated, based on the accessibility of the construction sites, and availability of the construction professionals in spite of their busy schedules. Thus,

the cluster sampling technique was adopted in the phase and questionnaire administration (quantitative data collection), for easy and fast generalisation of findings.

A purposive sampling is a useful method of extracting information from a sample of the population (i.e. chosen respondents) whose experience and knowledge are relevant and required for the subject matter under investigation (Creswell, 2007:9; Walliman, 2005:13). Purposive sampling technique was used to select Lagos, Nigeria, based on its wide range of employees from different backgrounds and extensiveness of its service provision for an extended period of time for the nation. The primary consideration in purposive sampling is careful judgement as to who can provide the best information to achieve the objectives of the study. Researchers gravitate to those people who, in their opinion, are likely to have the required information and a willingness to share it (Jumar, 2011:189). For this study, the purposive sampling method was used in selecting the sample for the qualitative phase whilst cluster sampling was used during the quantitative phase.

3.6 Questionnaire design

3.6.1 Types of questionnaires

Questionnaires, tools for data collection, present questions and statements organised to acquire information from research respondents without having to speak directly to the respondents (Adlers & Clark, 2008:216). But questionnaires are designed to be as flexible as possible and must be utilised appropriately to address issues relevant to the research at hand (Walliman, 2005:281; Flick, 2011:51). The questionnaire design phase is an extremely important phase of research because it aids the realisation of the research objectives (Maree & Pieterson, 2007:158). Hence, the process of questionnaire design requires the researcher consider the type of data to collect and the method of data analysis to be implemented. Dahlberg and McCaig (2010:20) further buttressed that inadequately designed questionnaires impede the obtaining of relevant and sufficient information in research. Therefore, to generate a well-structured and adequate questionnaire, the following must be given due attention by the researcher, as enumerated by Maree and Pieterson (2007: 159):

- The total appearance of the questionnaire, meaning the font and paper quality;
- The sequencing of the questions (easy to answer questions);
- The response categories; and
- The wording of questions (carefully selected clear words).

According to Bell (2005, as cited in Maree & Pieterson, 2007:160) questionnaires are of various forms, but are mainly divided into two categories, namely:

- open-ended questions; and
- closed-ended questions.

3.6.2 Open-ended questionnaires

Open-ended questions are questions asked without a specific guide or patterns for the answer to the questions. These questions are usually designed with the participants' undiluted opinions in mind (Maree & Pieterson, 2007:160). The respondents can provide comments and express their opinions without reservation (Kumar, 2011:151). As such, Hopkins (2008:104) confirmed that although closed-ended questions are usually used to test research hypothesis, open-ended questions are most appropriate in generating the research hypothesis. He added that open-ended questions tend to explore and discover validity and reliability of the questionnaire. The following, according to Maree and Pieterson (2007:161) and Leedy and Ormrod (2010:190), are the advantages and disadvantages of open-ended questions:

Advantages

- The participants respond to questions honestly, assured of anonymity;
- The respondents' opinions are revealed; and
- Complex question are duly answered with detailed justifications (Denscombe, 2003:156).

Disadvantages

- Data coding poses a difficulty;
- Time is required for respondents to complete (thinking and writing);
- Answers are invariably different in content because of the unstructured nature of the questions; and
- The use of statistical analysis in this design has proven abortive (Denscombe, 2003:156).

3.6.3 Closed-ended questionnaires

Closed-ended questions are structured questions intended to obtain unified responses from participants. The closed-ended questionnaires provide a set of sequential questions, requesting the respondents to choose the most appropriate answers (Maree & Pieterson, 2007:161). According to Kumar (2011:161), the use of closed-ended questions in research gives the researcher the benefit of obtaining sufficient information to reach a more

generalisable conclusion. Leedy and Ormrod (2010:7) further buttressed the following advantages of the closed-ended question method for research:

Advantages

- The questions are short, precise and easy to answer; and
- Coding and statistical analysis are easily done.

However, despite the numerous advantages of closed-ended questions, Maree and Peterson (2007:163) stated the following disadvantages of relying on closed-ended questions:

Disadvantages

- The answers are very simple with no background details;
- Respondents may be cajoled into giving answers they wouldn't otherwise have given;
- Answering the questions are too easy: answers given may mislead the researcher;
- The respondents' opinions might not be an option to choose from; and
- The questionnaires are nearly always too lengthy.

3.6.4 Format of the questionnaire

The research questionnaire, designed using closed-ended questions, was designed based on the information derived from the reviewed literature in correlation to objectives of the study. The questionnaire was structured in sections, where each section addresses an objective or objectives. The first section of the questionnaire inquires about the biographical information of the survey participants. The second section comprises questions to evaluate project characteristics to determine the nature and type of building under investigation. The third section of the questionnaire enquires into the sources of NVAAs, and is sub-sectioned into three groups made up of the flow of materials, the work of men, and information and documentation. Section four enquires into the causes of NVAAs. Section five relates to the effect of NVAAs, and section six solicits information pertaining to the mitigation of NVAAs. The final part of the questionnaire rated the Nigerian construction industry in terms of frequency of NVAAs.

Maree and Pietersen (2007:161) states that closed-ended questions gives allowance for a respondents to choose from a set of responses. The benefit of these questions is for quick and easy coding and statistical analysis. Closed-ended questions generate categorical and scalable data. Nominal and ordinal data are contained in categorical data and are a compilation of respondents profile and project.

Maree and Pietersen (2007:167) indicates that using scales to measure how respondents feel is very common and useful in survey research. Furthermore, the Likert scale is convenient when a researcher intends to measure a construct as this is accomplished by asking a series of Likert scale questions and then calculating a total score for each respondent, that is, assigning the value 1 to 5 (if five categories are used) to the categories and then adding the respondent's values based on the responses. So, for this study, the 5-point Likert scale was used. Categories were arranged as follows: 1 = Extremely minor, 2 = Less minor, 3 = Minor, 4 = Less major, 5 = Major and U = unsure. The Unsure option has been placed, not in the middle, but just after the extreme end of the scale, to prevent respondents from drifting to neutrality in their responses.

3.6.5 Piloting the questionnaire

Leedy and Ormrod (2010:110) argue that it is sometimes needed for a researcher to conduct a brief exploratory or pilot study to test procedures and instruments. Fellows and Liu (2008:155) opines the testing of all questionnaires through a pilot study that involves the initial administration of the questionnaires to respondents to test.

Before the questionnaires are disseminated to the intended respondents, it was decided that it would be ideal to pilot the questionnaire with an intended audience, acquiring their perception on the questionnaire design. Purpose of piloting the questionnaire was imperative because some aspects of the questions in the questionnaire might be difficult for the participants to understand, unless proper explanation is given in an appropriate manner. As a result of the initial input, the questionnaire was piloted amongst construction professionals and contractors working in the Nigeria construction industry. Piloting the research tool assisted in determining the clarity of answers for the research questions, using data generated from the questionnaires before proceeding to the main study.

3.7 Administration of the survey

The questionnaires were distributed by hand to the various target groups. Walliman (2005:282) indicates that the advantages of personal delivery are that respondents can be assisted in overcoming difficulties with certain questions, and that personal persuasion and reminders by the researcher can ensure a higher response rate. Indeed, the reasons why some people refused to complete the questionnaire were established, and there was a probability of checking responses if they seemed incomplete (Walliman, 2005:282).

3.8 Validity of the instrument and data

According to David and Sutton (2004:171) validity is the degree to which a measuring instrument measures and describes the concept it was designed to. Fellows and Liu (2008:143) indicate that in investigating a hypothesised causal relationship between an independent variable and dependent variable, inferences should be drawn, if such relationship is discovered. Research like this involves a set of validities, or in other words, the likely truth of a hypothesis (Fellows & Liu, 2008:143). For this particular research study, validity has been ensured in response to basic questions proposed by Leedy and Ormrod (2010:97) relating to both internal and external validity, respectively.

3.9 Data analysis for the study

The processes involved in data analysis include data testing, tabulation, categorising and examination of results to address the research problems (Yin, 2003:41). Quantitative analysis, carried out with the use of Statistical Package for Social Sciences (SPSS) software, was obtained by questionnaires and analysed with descriptive statistics.

Conversely, the qualitative data will be analysed technically by content analysis. The analysis of qualitative data consists of analysing thematically from the raw data all points that need to be considered as relevant to the topic under investigation (O'Leary, 2004:11).

3.9.1 Statistical tools for data analysis

In this study, the descriptive survey method was adopted, where a hundred and fifty (150) structured questionnaires were distributed administered to key players in the construction industry, including contractors, site engineers, site supervisor and artisans. The study adopted the use of frequency and percentages for the descriptive data. The completed questionnaires were analysed using SPSS having carefully completed the variable view and inputted the extracted data appropriately on the data view. The research objectives were achieved using mean score, standard deviation and spearman rank order correlations.

3.9.2 Spearman rank order correlation

The spearman rank order correlation is a non-parametric statistic with the following advantages (Zar, 2014:3):

1. Using the software is not restricted and it has minimal chances of being used improperly;

2. It has an effective use even when data are measured on weak measurement scales;

3. It is easy to compute and interpret.

3.9.3 Descriptive statistics

Descriptive statistical analysis in exploratory research can be defined as a process of illustrating or summarising a set of quantitative data in easily understandable formats such as tables and chats (Quartaroli, 2009). The descriptive statistics present a basic overview of each data variable by using descriptive statistical tools (O'Leary, 2010:124). Stead and Struwig (2007:12) opined that the purpose for the use of statistical tools in data analysis is to present a straightforward and pictorial representation of a large data set. Henn (2006) and Leedy and Ormrod (2010:18) identified that central tendency measurement, dispersion measurements and frequency distributions are the three prescribed terms predominately used in descriptive statistical data analysis. Hence, this study adopted the use of frequency distribution and central tendency measurement techniques (mean and standard deviations) in analysing the quantitative data obtained from the survey.

3.10. Limitations of the study

The major limitation of this study was the reluctance of some of the respondents to find time to complete and return the questionnaires, even after the researcher's attempts to persuade them to do so.

3.11 Chapter summary

This chapter provided a comprehensive overview of the research methodology adopted in the study. A mixed research method (quantitative and qualitative) was adopted to achieve the aim and objectives of the research. The quantitative research questionnaire was designed to obtain the perceptions of construction workers and stakeholders to identify NVAAs; interviews and questionnaires were used in collecting the primary and secondary data for the study. The approach used for questionnaire administration was the 'hand-in' approach.

CHAPTER 4
DATA ANALYSIS AND DISCUSION OF FINDINGS

4.1 Introduction

This chapter is subdivided into various sections presenting the empirical data compiled through closed-ended questionnaires, survey and interviews conducted with construction professionals. The results of the data analysis, using both descriptive and inferential statistical techniques, are reported in this chapter. Detailed accounts of participant responses during the qualitative interviews conducted for this research were reported and tabulated under appropriate sections. The results of statistical analysis were interpreted; inferences were drawn from the results and discussed exhaustively to bring research outcomes into focus.

4.2 Findings from the exploratory study

4.2.1 Justification of adopting the exploratory study

The qualitative method was adopted, and open-ended interviews were administered to purposive selected construction professionals including consulting engineers, site engineers, site managers, and construction managers who were based in Lagos. Observations of construction activities on sites also provided the basis for the primary data collection to gain an in-depth understanding of the factors contributing to the occurrence of NVAAs on site. This was to gather data as empirical evidence of the existence of non-value adding activities in Nigerian construction sites. The construction site visit, the observation of site layout, and movement of people and equipment, along with interviews with on-site personnel, provided more insight into the existence of NVAAs. Three cases were selected for the investigation, and a total of eight respondents participating in the interviews. The salient findings revealed that inadequate planning of construction site activities, such as site layout, management of materials, and the (in)competency of site personnel contributed to non-value adding activities; hence, this confirms the status of poor site performance in the construction industry. The study was limited to select building construction projects in Lagos, Nigeria. Particularly, attention was directed mainly on the appraisal of non-value adding activities pertaining to site management in the construction industry during the project execution phase.

A semi-structured interview was administered to construction site personnel including project managers, site managers and construction managers. The semi-structured interviews was designed based on the review of literature as discussed in chapter 2 of this thesis.

In total, eight site personnel were interviewed by means of predesigned questions and a voice recorder. The questionnaire was divided into four separate sections relating to the perceived root source of NVAAs, the detrimental effect of NVAAs on project performance, mechanisms for reducing / preventing the prevalence of NVAAs, and quality management systems for alleviating NVAAs in construction projects. Each interview session was tape recorded and lasted at least 45 minutes, and it is worth noting that as discussions took place, physical observations were noted whenever needed for better clarification, as well as observation of site layouts and material stacking. A digital camera was used to take pictures where interesting cases were seen.

4.2.2 Description of sites visited and observations

All the firms selected for the case study were private owned companies located in Lekki-Aja area in Lagos. Company A was a private building construction firm specialising in the building of structures. Company B was a building construction firm, involved in management, selling completed buildings; and specialising in developing innovative and unparalleled luxury apartments, duplexes, detached homes and commercial outlets. Company C specialised in building construction. The semi-structured interview was administered directly to eight construction professionals, and their positions are depicted in Table 4.1:

Table 4.1: Designation and experience of interviewees

Respondent	Designation	Company	Experience (years)
Respondent 1	Site manager	A	11
Respondent 2	Consulting quality engineer	A	7
Respondent 3	Builder/site engineer	A	16
Respondent 4	Site engineer	A	11
Respondent 5	Site engineer	B	11
Respondent 6	Site manager	B	8
Respondent 7	Site engineer	C	13
Respondent 8	Site manager	C	12

It is important to note from Table 4.1 that the highest work experience of the survey participants in the construction industry was 16 years, while the least work experience was 7 years. This indicates a reasonably high work experience profile of respondents. The interviewees were involved in the daily activities as they worked either as project managers, site managers and construction managers.

4.2.3 Observation of the existence of NVAAs on site

The observation during a visit to three construction sites of three different companies (shown in Figure 4.1, Figure 4.2, and Figure 4.3, respectively) revealed numerous activities that added no value during the construction process, thereby creating much wastage, such as of time and money. The piling up of materials, at the same time and in the same places, was also one of the observations, evidence of a problem not only with the site plan but also with the programme of work.

Figure 4.2 reveals that scaffolding materials, bricks and sharp sand were all piled up alongside waste materials; left uncleaned, this will lead to materials mixing up and separation of good material from bad becomes problematic. Any attempt to rectify this will lead to time and labour wastage, which, if considered from the early stage, would have been alleviated.

Figure 4.1: Indiscriminate stacking of materials

Figure 4.2 shows the stacking of bricks on the pathway leading to the building, with reinforcement bars laying on the floor and an excavating machine abandoned at the same working space. The interview revealed that the machine was rented by the contractor, but with the materials piled in its way, it isn't able to be moved/used until the materials are used up or cleared. This incurs an extra cost because there is a certain time frame for the machine to be used. All this contributes to waste and thus leads to NVAAs.

Figure 4.2: Piling of material arbitrarily

Figure 4.3 also depicts the same haphazard way of storing materials and this goes a long way in affecting the site plan because it distorts movement of man, plant, and materials and constitute NVAAs.

Figure 4.3: Abnormal way of piling materials on site

4.2.4 Analysis of qualitative interview and findings

The qualitative collection phase employed the construct validity technique, a technique adopted to ensure that the findings obtained in research measures what it claims to measure. The findings from the quantitative data analysis were framed into interview questions to confirm if the quantitative results answered what they portray to answer about the research aim and objectives. Three (3) construction companies were elected for the interview. The researcher scheduled appointments for each interview with the respondents to ensure efficient research time management. Eight (8) construction professionals were interviewed on construction sites A, B and C. The interview session conducted with each interviewee started

with an introduction of the research title and the purpose of the study. A copy of the interview guideline is found in Appendix A.

4.2.5 Causes of NVAAs in building operations

4.2.5.1 Repair on finishing works

Interviewees pointed out that repairs on finishing works were one of the major issues contributing to NVAAs in the firms surveyed. Repair is defined as an activity that must be redone or altered, typically caused by design error (Nagapan & Zin, 2012:26). This is a fact because rework is a waste, whether due to design error, omissions, changes or mistakes. Repairs include variations and can occur any time and within any activity during construction. In this case, repairs of finishing works include casting work, tile works, ceiling works, painting, brickwork and plastering. Two of the site managers interviewed believed repairs on finishing works are common cause of NVAAs. The interviewees stressed the fact that certain construction activities require specific tools that require a more highly skilled labour force and experience to fulfil the clients' finishing requirement. One of the site managers who has been working in the construction industry for 12 years opined that the incidence of repair on finishing works is not only a result of lack of skilled labour and poor quality of materials used, but also due to the failure of other construction works, such as mechanical, electrical, and structural work.

4.2.5.2 Waiting for materials by site managers

Materials are a huge component of construction cost and make up a large part of construction cost. However, findings from the interview indicated that there is a lack of material management systems are presently effective in the construction industry. Inspection of materials, delivery, handling and storage before installation constitute material acquisition in construction. A lack of mechanisms in place for managing materials during construction projects result in waiting for material on site. The respondents affirm that waiting for materials not only comprise waiting for material deliveries to site by materials suppliers, but also waiting for material deliveries from storage on site to certain areas of the construction site. According to one of the site managers, proper site layout is essential and thus should be designed appropriately to facilitate the flow of materials without any form of interruption. The site manager further opined that this mechanism will assist in reducing the waiting time for materials to a large extent during the construction phase. Also, adequate communication networks must be established with suppliers. The suppliers ensure that all work stages are monitored for progress. This can be achieved best by giving site management the authority to directly communicate directly with suppliers directly regarding materials needed on site.

4.2.5.3 Delays to schedule

It was revealed by the respondents that delays can be accounted for by a series of reasons such as fluctuating weather, lack of skills on the part to tradesmen, poor project planning and scheduling, inefficient material delivery to site, design changes, and slow decision making. Interviewees from different firms perceived that schedule delays was one of the crucial factors negatively influencing the performance of construction projects thereby contributing to non-value adding activities on site.

4.2.5.4 Design changes

Choy and Sidwell (1991:25) described design changes as any alteration made to scope of work as stated in the contract documents after the creation of legal relations between the principal agent and contractor. Most times, design changes do not emanate from the contractors. Design changes may occur in architectural, structural, plumbing and drainage, site works or other aspects of construction. It was confirmed from the interviewees that design changes are usually as a result of owners' demands or clients' requests for changes to design to meet changing preferences. Unforeseen circumstances and problems in material acquisition could result in design changes.

4.2.5.5 Slow decision making by the site managers

In the execution of construction activities, decision making is key especially when carrying out duties during construction. Careful information collection and analysis, troubleshooting often leads to good decisions. It usually entails having to choose between several causes of action. If the choices made are accurate, the problem emerge into a regular course of successful action. If there is an uncertainty about the choices, the problem is non-routine and the site managers may consume a large amount of time examining various options before reaching a final decision.

Clients or consultants as well as contractor's personnel could be the cause of slow decision making. For instance, one of the site managers was of the opinion that slow decision making on the part of clients leads to delays in schedule. To ensure delays are avoided in the execution of construction projects, contractors must be proactive when communicating between owner representatives and workers on site.

4.2.5.6 Lack of trade skill

Human beings are perceived as highly important in the successful completion of construction projects. Tradesmen/labourers, site workers and supervisors/inspectors can be categorized into this group. The success of any construction project significantly depends on the performance of the artisans and field labour. According to the interviewees (site manager and

site engineers), contractors inability to complete project satisfactorily is due to managerial issues such as engaging tradesmen with inadequate skills. In effect, observations during the site visit proved that 'skilled' operators were often actually not skilful, they rather learn on the job through trial and error methods in order to gain hands-on experience. It was also noted that majority of the tradesmen do not use their own initiative, but instead rely on both the trade foremen and the supervisors to check and approve all site activities. For this reason, site managers have developed their own formal 'in-house' training and evaluation programmes. Labour as a resource has specific characteristics. The production output of labour is a function of skill and motivation. From the interviews, it was evident that the building construction industry in Nigeria have similar problems to other developing countries: that is, poor labour productivity as a result of NVAAs.

4.2.6 Causes of NVAAs from limitation of construction personnel

4.2.6.1 Site management and supervision

Poor site management and poor supervision were determined to be major factors contributing to NVAAs on the sites visited; the interviews conducted on the three case studies revealed that a substantial amount of construction waste is due mostly to inadequate supervision and site management related issues as stacking of both used and unused materials were done haphazardly without taken into consideration the site layout.

4.2.6.2 Lack of experience

Lack of experience was another key factor contributing to construction waste. The survey participants highlighted that in most of the contracts, tradesmen had little or no experience in construction. More so, managerial incompetence contributed to more defective works and reworks in the Nigerian construction industry, primarily because of inexperienced field supervisors.

4.2.6.3 Inadequate planning and scheduling

The analysis of the qualitative survey revealed that poor planning and scheduling contributed to NVAAs on most of the projects investigated. The respondents stated that poor planning was one of the most significant factors contributing to waste generation, since this leads to the interruption of the flow of material supply and rework to the building (indirect waste).

4.2.6.4 Mistakes during construction

According to the respondents, one of the significant factors that influenced the occurrence of NVAAs on site was mistakes during construction. The respondents pointed out that mistakes resulting in NVAAs was due to human limitations. This factor often result in redoing an activity which was wrongly done the first time, thereby leading to demolishing and rebuilding to effect the necessary correction; hence, this ends up wasting material, time and labour.

4.2.7 Impact of NVAAs

The findings from the qualitative analysis indicate that NVAAs have a negative impact on construction projects in various forms. It was evident that NVAAs associated with rework contributed significantly to cost increases in most of the construction projects investigated. Over time, that seems to be a standard rather the exception in the construction industry, negatively impacting productivity and increasing fatigue and accidents, eventually increasing cost and time spent on construction projects (Hanna, 2005:734). All the respondents unanimously agreed that if NVAAs continuous to occur unabatedly without having systems in place to minimise its occurrence, they will have a detrimental effect on the competitiveness of organisations and subsequently affect productivity of the industry as a whole.

4.2.8 Measures for minimisation of the occurrence of NVAAs

A detailed waste minimisation strategy comprising of careful planning throughout the design, implementation and occupancy phases, to ensure its success, effectiveness and compliance with building regulations may assist in monitoring and managing the different waste streams during construction. Respondents identified a number of mechanisms to be established for waste minimisation. Nevertheless, from the researcher observation on site, there was unfortunately no evidence that these mechanisms were implemented. Prevention of waste is important and should be addressed from the onset by identifying possible waste streams in the construction process and implementing the design for minimisation. Effective communication networks should be developed between building professionals to ensure accurate calculations of materials required to avoid waste. The most appropriate method to use in the events of waste production, is reuse either on the existing site or a nearby site. Waste materials on site can be recycled or sold out to offset the cost of another building project. However, identification of materials that can be reused or recycled needs to be done at the early stages of the construction process, and then separated for storage for storage, collection and transfer.

4.2.9 Quality management issues

According to Zairi (1991:14), *quality management* is "that aspect of the overall management function that determines and implements the quality policy and as such, is the responsibility of the top management". *Quality management* refers to all activities of the overall management function that determine the quality policy, objectives and responsibilities, and the implementation of these by means such as quality planning, quality control, quality assurance and quality improvement within the entire quality system. The findings from the case studies divulged that there are existing techniques for quality control such as education and training, testing and measurement of work done, improved craftsmanship, improved employee-management relationship and stronger prequalification criteria. While it was evident that interviewees were aware of quality improvement measures, the implementation is still problematic and this then affects site operation performance. Love and Li (2000:489) explained that performance improvement in the construction industry can be achieved if all organisations involved in the project supply chain make the necessary effort to implement quality management practices.

4.3 Analysis of the main study

Data collection for the study was carried out in Lagos, Nigeria, through administration of the study questionnaire to construction professionals working in construction firms by the researcher. One hundred and fifty questionnaires (150) were distributed to construction industry workers (site managers, site supervisors, estimators, quantify surveyors, architects and project managers) in the building construction industry. Companies were randomly selected and the study survey instruments were hand delivered to the site offices of the companies. However, due to the busy nature of these professionals in their respective organisations, only 115 of the 150 questionnaires were returned, out of which only 92 were found suitable for analysis. The total number of questionnaires found suitable for analysis represented 37% of the total number of questionnaires distributed.

4.4 Analysis of the respondents' biographical information

Analysis of respondents' demographic information is presented in Table 4.1 and Table 4.2. Results in Table 4.1 show that approximately 87% of the respondents were male while only 13% were female. Information regarding the position of the respondents in their various organisations was also requested, with results of the analysis revealing that 39% were site supervisors in their company, approximately 21% were project managers, 12% were estimator/quantity surveyors, approximately 9% were site managers, 3% were architects, 3%

were site engineers and approximately 5% held other positions. To analyse further into the expertise of the respondents, the study also sought information on their years of working experience; the results of frequency analysis in Table 4.1 depicts information regarding a long time of working background of respondents in the construction industry: 12% had 0-5 years' working experience, 38% had 6-10 years' working experience, 29% had 11-15 years' experience, and 20% had 16 years' working experience.

Apart from information relating to the expertise and competency of the respondents, this study sought information on the strength of the company where the respondents are working. The results show that 51% of the organisations execute projects for public sector clients only, 29% execute projects for private sector clients only and the remaining 19% of the organisations, representing the minority, execute projects for both public and private sector clients.

Table 4.2 also presents the results on the qualification of respondents in the construction industry who responded, with analysis showing that 26% had Master's degrees; approximately 24% had a Higher National Diploma; 22% had BSc. degrees; those with Doctorate degrees and BSc Honours comprised approximately 7%; 4% had a National Diploma; and 3% were SSCE. From the foregoing discussion of the analysis of results in Table 4.2, the respondents' demographic and background information shows that the respondents sampled were qualified and experienced practitioners in the construction industry, whose judgments on issues of NVAAs in the construction industry should be considered reliable. It can be inferred that the information provided by these sets of respondents is adequate and their opinions are of good judgement of the subject of NVAAs in construction projects.

Table 4.2: Biographical information of study participants

Respondents information		Frequency	Valid Percent
Gender	Male	80	87.0
	Female	12	13.0
	Total	92	100.0
Sector of respondent company	Private	27	29.3
	Public	47	51.1
	Both	18	19.6
	Total	**92**	**100.0**
Years of working experience in construction industry	0-5 yrs	11	12.0
	6-10 yrs	35	38.0
	11-15 yrs	27	29.3
	16 and above	19	20.7
	Total	**92**	**100.0**
Position of respondents in the company	Site Manager	8	8.7
	Site Supervisor	36	39.1
	Project Manager	19	20.7
	Director	7	7.6
	Architect	3	3.3
	Site Engineer	3	3.3
	Estimator/QS	11	12.0
	Others	5	5.4
	Total	**92**	**100.0**
Respondents' educational qualification	SSCE	3	3.3
	National Diploma (ND)	4	4.3
	Higher National Diploma (HND)	22	23.9
	BSc Degree	20	21.7
	BSc Honours	6	6.5
	Master's Degree	24	26.1
	Doctorate Degree (PhD)	6	6.5
	Others	7	7.6
	Total	**92**	**100.0**

4.5 Analysis of the characteristics of the project

Information was sought from respondents on the project type, with responses of respondents presented in Figure 4.4. Results reveal that 51.1% were handling new building projects, 33.7% were refurbishment/renovation, and other buildings projects claimed 15.2%. Then, 19.6% of the building projects involved administrative buildings; 19.6% were educational buildings; 17.4% were residential buildings; 12% were building for commercial purposes; 7.6% were

hotel/motel/resort, banks and industrial buildings; 6.5% were buildings for hospital/health; and 2.2% were buildings meant for entertainment purpose.

Table 4: 3: Descriptive analysis of the type of project

Building project information		Frequency	Valid Percent	Cumulative Percent
Project type	New building	47	51.1	51.1
	Refurbishment / Renovation	31	33.7	84.8
	Others	14	15.2	100.0
	Total	**92**	**100.0**	
Building Facility type/usage	Administrative	18	19.6	19.6
	Banks	7	7.6	27.2
	Educational	18	19.6	46.7
	Entertainment	2	2.2	48.9
	Hospitals/Health	6	6.5	55.4
	Commercial	11	12.0	67.4
	Hotel/Motel/Resort	7	7.6	75.0
	Industrial	7	7.6	82.6
	Residential	16	17.4	100.0
	Total	**92**	**100.0**	

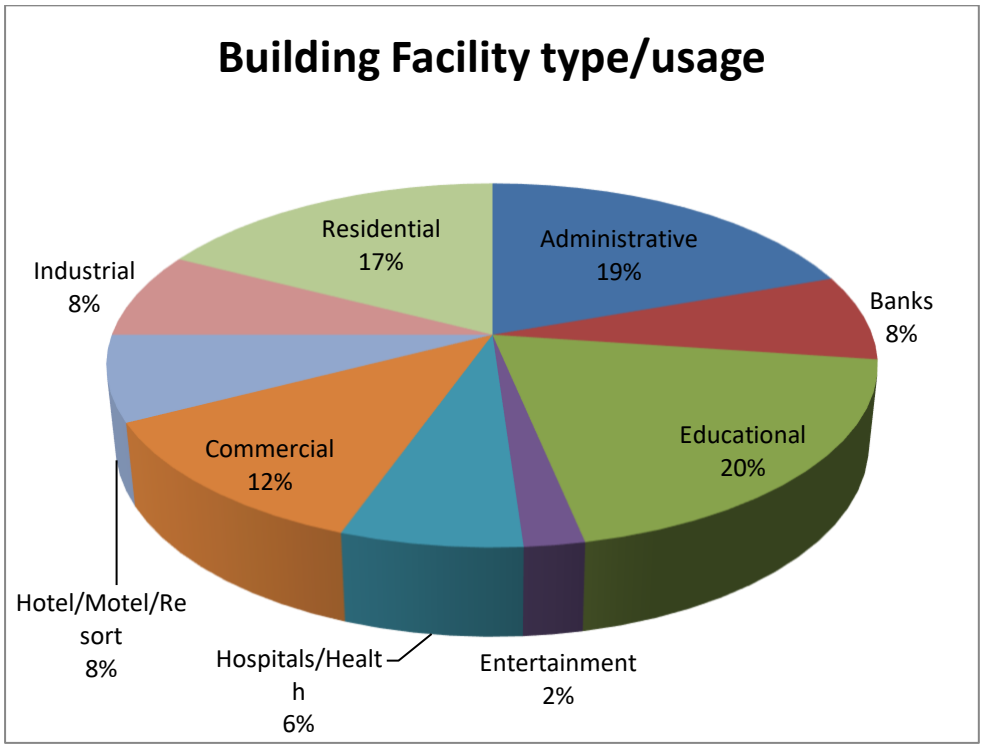

Figure 4.4: Descriptive analysis of the characteristics of the project

4.6 Frequency analysis of cost, time and size of executed building projects

Table 4.4 presents the cost, time and size of executed building projects: 38% has less than 50 million naira as the original tender sum; 17.4% was above 200 million naira; 17.4% has less than 150 million naira; and 9.8 million as the original tender sum of the project executed. Table 4.3 presents findings on the cost of the final projects executed: 40.2% was less than 50 million naira; 18.5% was above 200 million naira; 17.4% was less than 150 million; 12.0% was less than 200 million; and 12.0% was less than 100 million naira.

Table 4.4 also presents the analysis of the contract period of the projects handled by the respondents: 38% was less than 12 months; 32.6% was less than 24 months; 17.4% was less than 36 months; and 12% was above 36 months. Table 4.4 further presents the actual construction period of project executed: 37% was less than 24 months; 26% was less than 36 months; 19.6% was less than 12 months; and 17.4% was less than 36 months.

Table 4: 4: Analysis of the characteristics of the project

Project: cost, time and size information		Frequency	Valid Percent	Cumulative Percent
Original Tender Sum	<50 million	35	38.0	38.0
	>50 < 100 million	9	9.8	47.8
	>100 <150 million	16	17.4	65.2
	>150 <200 million	16	17.4	82.6
	above 200 million	16	17.4	100.0
	Total	**92**	**100.0**	
Final Project Cost	<50 million	37	40.2	40.2
	>50 < 100 million	11	12.0	52.2
	>100 <150 million	16	17.4	69.6
	>150 <200 million	11	12.0	81.5
	above 200 million	17	18.5	100.0
	Total	**92**	**100.0**	
Initial contract period	<12 months	35	38.0	38.0
	>12 <24 months	30	32.6	70.7
	>24 <36 months	16	17.4	88.0
	above 36 months	11	12.0	100.0
	Total	**92**	**100.0**	
Actual Construction period	<12 months	18	19.6	19.6
	>12 <24 months	34	37.0	56.5
	>24 <36 months	24	26.1	82.6
	above 36 months	16	17.4	100.0
	Total	**92**	**100.0**	
Gross Floor Area (m2) of the Building	<500 m2	52	56.5	56.5
	>500 <1000 m2	9	9.8	66.3
	>1000 <2000 m2	12	13.0	79.3
	>2000 m2	19	20.7	100.0
	Total	**92**	**100.0**	
Number of Floors	Single floor building	24	26.1	26.1
	Two floors building	38	41.3	67.4
	Three floors building	26	28.3	95.7
	Four floors building	3	3.3	98.9
	More than four floors building	1	1.1	100.0
	Total	**92**	**100.0**	

4.7 Reliability testing

The reliability of the research scale questions was assessed using Cronbach's alpha co-efficient. The basic assumption of the Cronbach's alpha co-efficient is that the optimal co-efficient alpha should be above 0.7 since the closer the co-efficient is to 1, the more reliable

the scale and the survey instrument. Thus, the results of Cronbach's reliability test are presented in Table 4.5 below.

Table 4.5: Reliability of the research instrument

Section	Statement	Number of items	Cronbach's alpha co-efficient
C	Sources of NVAAs	18	0.9
D	Causes of NVAAs	21	0.9
E	Effects of NVAAs on project performance	16	0.8
F	Mitigation to NVAAs occurrence	16	0.8

Table 4.5 results show that the Cronbach's alpha co-efficient values are greater than 0.7; this is, however, in agreement with the assertion of Tavakol and Dennick (2011:53) and Pallant (2011:100) that co-efficient alpha value above 0.7 is good, while the coefficient value above 0.8 is preferable. The results in Table 4.5 thus confirm that the questionnaire instrument used for the research is dependable and adequate since the alpha coefficient values of all the scales are between 0.8 and 0.9.

4.8 Analysis on sources of NVAAs in building projects

One of the cardinal objectives of this study is to identify the occurrence of NVAAs in the Nigerian construction industry. In Table 4.6, the results of the analysis on the identified NVAAs were presented on a 5-point Likert scale, where 1 = extremely minor, 2 = less minor, 3 = minor, 4 = less major, and 5 = major. The results of analysis were ranked using the mean score value to identify the sources of NVAAs on construction projects.

The sources were sub-divided into sections comprised of sources because of flow of materials, in which delay in material transportation was ranked first with a mean score value of 3.000. Poor coordination of material on site and unnecessary material handling were jointly ranked 2nd with mean scores of 2.848, followed by aggressive handling of materials with a mean score of 2.750. The findings indicate that respondents tended to agree, to some extent, that delays in material transportation contributed to NVAAs since the mean score is 3. However, respondents concurred that poor coordination of material on site, unnecessary material handling, and aggressive handling of materials contribution to NVAAs is deemed to be near a minor extent, since their mean score is only between 2 and 3.

Sources of NVAAs that arise from workers was further analysed, and idleness of workmen due to poor work sequencing was ranked first, with a mean value of 3.011, followed by low

employee morale (2.978) and defective workmanship due to human errors or mistakes (2.935). Inadequate supervision on site had a mean value of 2.880 and ranked fourth. This implies that respondents tend to agree that idleness of workmen due to poor work sequencing can contribute to NVAAs to some extent, since the mean score is 3. On the other hand, respondent agreement that low employee morale, defective workmanship due to human errors or mistakes and inadequate supervision on site contribute to NVAAs is between near minor extent to some extent, since the mean score is between 2 and 3.

Table 4.6 further shows the analysis of sources of NVAAs that arise because of information and documentation. The ranking of the mean shows that incomplete drawings/design at the time of tender (with a mean score value of 3.033) is ranked first, late dissemination of information was ranked second (with a mean score value of 2.967) and contradiction in design documents was ranked third (with a mean score value of 2.946). The fourth ranked variable in this category was errors in materials specification (with a mean score of 2.913). Analysis of the findings shows that respondents tends to agree to some extent that incomplete drawing/design at the time of tender is a major source of NVAAs, since the mean score is 3. However, respondents concurred that late dissemination of information and contradiction in design document contribute to the source of NVAAs is deemed to be between a near minor extent to some extent, since their mean score is between 2 and 3.

Table 4: 6: Analysis of the sources of Non-value adding activities

Sources of NVAAs	Frequency (Percent) Minor 1	2	3	4	Major 5	Mean	Std. Deviation	Ranking
Flow of Materials								
Delays in Material Transportation	5.4	34.8	25.0	23.9	10.9	3.000	1.119	1
Poor Coordination of Materials on Site	7.6	37.0	28.3	17.4	9.8	2.848	1.109	2
Unnecessary Material Handling	20.7	21.7	26.1	16.3	15.2	2.848	1.119	2
Aggressive Handling of Materials leading to Cracks	9.8	29.3	42.4	13.0	5.4	2.750	0.990	4
Inappropriate Dumping of Building Materials	16.3%	33.7	27.2	14.1	8.7	2.652	1.171	5
Work of men								
Idleness of Workmen due to Poor Work Sequencing	8.7	23.9	33.7	25.0	8.7	3.011	1.094	1
Low Employee Morale	8.7	25.0	32.6	27.2	6.5	2.978	1.069	2
Defective Workmanship due to Human errors or Mistake	9.8	31.5	21.7	29.3	7.6	2.935	1.146	3
Inadequate Supervision on Site	13.0	25.0	31.5	21.7	8.7	2.880	1.156	4
Lack of Required Competencies of Construction Workers	20.7	21.7	26.1	16.3	15.2	2.837	1.345	5
Information and documentation								
Incomplete Drawings/Design at the time of tender	15.2	20.7	25.0	23.9	15.2	3.033	1.296	1
Late dissemination of Information	5.4	32.6	28.3	27.2	6.5	2.967	1.043	2
Contradiction in Design Documents	15.2	20.7	29.3	23.9	10.9	2.946	1.226	3
Errors in Material Specification	18.5	19.6	27.2	21.7	13.0	2.913	1.298	4
Omission of Item(s) from the Contract Documentation	16.3	21.7	25.0	29.3	7.6	2.902	1.214	5
Unclear and Inadequate Design Details in Drawings	10.9	27.2	29.3	27.2	5.4	2.891	1.094	6
Unrealistic Project Execution Plans	10.9	34.8	21.7	27.2	5.4	2.815	1.119	7
Poor Document Control System	18.5	19.6	30.4	27.2	4.3	2.793	1.163	8

4.9 Analysis on the causes of NVAAs on building projects

Table 4.7 presents the analysis on the causes of NVAAs on buildings. Analysis results shows that poor ability to coordinate available resources was ranked first (with an MS of 3.130) followed by lack of appropriate personnel management skill by site management (with an MS of 3.087) ranked second, and lack of working experience as a cause of NVAAs to project performance ranked third (with an MS of 3.054). The fourth ranked was construction activities by site management (with an MS of 3.043). This implies that respondents tend to agree that external influences (weather/climate) on personnel, inadequate construction techniques by site management are, to an extent, causes of NVAAs, since the MS is 3. On the other hand, respondents agree that competency of site management personnel due to poor decision making abilities by site management contribute to the causes of NVAAs are between a near minor extent to some extent, since the MS is 2.

In analysis of causes of NVAAs on building projects, results show that respondents agreed that site setup (plants and equipment wrongly located) by site management ranked first (with an MS of 2.967), followed by improper dumping and storage of materials by site management (MS of 2.902) and site setup due to lack of proper site layout by site management and poor working space resulting from non-precise site set-up by site management ranked third (with an MS of 2.750) to an extent, contributing to causes of NVAAs, and can be a near minor. Likewise, movement of men by site management as a result of NVAAs to project performance (with an MS of 2.630) ranked forth since their MS are between 2 and 3 respectively.

Analysis of the causes of NVAAs in building, because of contract practices, shows that respondents were of the opinion that the communication system between contractor and client ranked first (with a mean score of 3.053) followed by rate of honesty and fairness among client, contractor and subcontractors to project performance (2.935) and sudden requirement of client after contract approval resulting in re-work (2.924) ranked third. Frequent design changes by site management had a mean score value of 2.870, ranking forth. This suggests that respondents tended to agree that conflict of interest, rate of compliance with legal obligation during contract period to project performance and rate of site management cooperation on site to poor project performance can be a near minor to an extent, since the mean score is between 2 and 3.

Table 4.7: Causes of NVAAs in building projects

Causes of NVAAs	Frequency (Percent) Unsure	Minor 1	2	3	4	Major 5	Mean	Std. Deviation	Ranking
Competency of site management personnel Poor ability to coordinate available resources	0.0	10.9	18.5	32.6	22.8	15.2	3.130	1.206	1
lack of appropriate Personnel Management skill by Site management	1.1	4.3	29.3	28.3	23.9	13.0	3.087	1.155	2
Lack of working Experience as a cause of NVAAs to Project Performance	0.0	7.6	25.0	32.6	23.9	10.9	3.054	1.113	3
Poor Planning of Construction Activities by Site management	0.0	12.0	21.7	26.1	30.4	9.8	3.043	1.185	4
Unnecessary Design Changes as a cause of NVAAs to Project Performance	0.0	13.0	20.7	28.3	27.2	10.9	3.022	1.204	5
External Influence (Weather & Climate) on Personnel	0.0	7.6	30.4	30.4	16.3	15.2	3.011	1.181	6
Inadequate Construction Techniques by Site management	0.0	10.9	25.0	29.3	22.8	12.0	3.000	1.186	7
Leadership Ability by Site management	0.0	14.1	19.6	30.4	25.0	10.9	2.989	1.209	8
Poor Decision Making ability by Site Management. Site setup	0.0	17.4	25.0	27.2	21.7	8.7	2.793	1.218	9
Poor site set-up (Plant & Equipment wrongly located) by Site management	0.0	7.6	27.2	31.5	28.3	5.4	2.967	1.043	1
Dumping and Storage of materials by Site management	0.0	8.7	29.3	30.4	26.1	5.4	2.902	1.059	2
Lack of proper Site layout by Site management	0.0	20.7	22.8	22.8	28.3	5.4	2.750	1.228	3
Poor working space resulting from non-precise site set-up by Site management	1.1	12.0	29.3	31.5	20.7	5.4	2.750	1.116	4
Movement of Men by Site Mgt. as a cause of NVAAs to project performance Contract practices	0.0	15.2	27.2	40.2	14.1	3.3	2.630	1.013	5
Communication System between Contractor & Client	0.0	6.5	33.7	21.7	25.0	13.0	3.043	1.176	1
Rate of Honesty and Fairness among Client, Contractor & Subcontractors to project performance	1.1	12.0	23.9	30.4	20.7	12.0	2.935	1.230	2
Sudden requirement of Client after contract approval resulting to re-work	1.1	12.0	25.0	26.1	27.2	8.7	2.924	1.207	3
Frequent Design changes by Site management	0.0	14.1	26.1	27.2	23.9	8.7	2.870	1.188	4
Conflict of Interest	0.0	13.0	26.1	30.4	23.9	6.5	2.848	1.128	5
Rate of Compliance with Legal Obligation during contract period to project performance	0.0	18.5	26.1	27.2	15.2	13.0	2.783	1.282	6
Rate of Site Management Cooperation on site to poor project performance	1.1	13.0	29.3	33.7	20.7	2.2	2.663	1.051	7

4.10 Descriptive analysis of effects of NVAAs on project performance

Table 4.8 presents an analysis of the effect of NVAAs on project performance, with the effect of quality of work done ranked first (with a mean score of 3.163), followed by effect of time overrun (3.087) second, and effect of cost overrun (3.043) ranked third. Effect of client dissatisfaction had a mean score of 3.011 and ranked forth. This means that effect of NVAAs on quality of work done can influence project execution and can affect project performance, since it has a mean score of 3. On the other hand, respondents tended to agree that effect of site set up (with a mean score 2.967) influences NVAAs to some extent is fairly minor since it had a mean score of 2.067, between 2 and 3.

Analysis on effect of overtime in organisations was done, with respondent claims showing that effect of variation was ranked first (with a mean score value of 3.250), followed by the second ranked which was the effect of disruption/interruption of activities (3.011), while effect of additional resource allocation (2.957) ranked third. Effect of clash/overlapping of activities had a mean score of 2.935 and ranked forth. From the claims, it seems that effect of variation and effect of disruption/interruption of activities can influence project execution and can affect the performance of projects to some extent, since the mean scores are 3. On the other hand, respondents agree that effect of damage to the environment, effect of incidents and accidents, effect of loss of future work, effect of reduced profit, effect of time-space conflict and effect of overtime as NVAAs can also affect project performance to an extent, since the mean score values range between 2 and 3. Also, effect of fatigue was claimed by respondents to be minor, since the mean score was between 1 and 2.

Table 4.8: Descriptive analysis of effects of NVAAs on project performance

Factors on effects of NVAAs	Frequency (Percent) Unsure	Minor 1	2	3	4	Major 5	Mean	Std. Deviation	Ranking
Project performance									
Effect of Quality of work done	0.0	6.5	19.6	41.3	16.3	16.3	3.163	1.122	1
Effect of Time Overrun	0.0	14.1	15.2	35.9	17.4	17.4	3.087	1.264	2
Effect of Cost Overrun	0.0	12.0	26.1	25.0	19.6	17.4	3.043	1.283	3
Effect of Client Dissatisfaction	0.0	9.8	25.0	27.2	30.4	7.6	3.011	1.124	4
Effect of Site Set-up	0.0	10.9	22.8	30.4	30.4	5.4	2.967	1.094	5
Organisation									
Effect of Variation and Claims	0.0	10.9	18.5	25.0	26.1	19.6	3.250	1.272	1
Effect of Disruption/Interruption of activities	0.0	8.7	25.0	26.1	37.0	3.3	3.011	1.053	2
Effect of additional resources allocation	0.0	12.0	17.4	39.1	26.1	5.4	2.957	1.068	3
Effect of Clash/Overlapping of activities	0.0	10.9	26.1	28.3	28.3	6.5	2.935	1.117	4
Effect of Damage to the Environment	0.0	18.5	21.7	22.8	23.9	13.0	2.913	1.315	5
Effect of Incidents and Accidents	0.0	10.9	30.4	29.3	16.3	13.0	2.902	1.196	6
Effect of Lost of Future work	0.0	13.0	26.1	30.4	20.7	9.8	2.880	1.175	7
Effect of Time-space conflict	0.0	12.0	21.7	40.2	19.6	6.5	2.870	1.071	8
Effect of Reduced profit	0.0	8.7	30.4	34.8	17.4	8.7	2.870	1.081	9
Effect of Overtime	0.0	13.0	26.1	33.7	18.5	8.7	2.837	1.141	10
Effect of Fatigue	0.0	12.0	32.6	31.5	17.4	6.5	2.739	1.088	11

4.11 Mitigating measures against the occurrence of NVAAs

Analysis on mitigation measures against the occurrence of NVAAs presented in Table 4.9 shows that respondent claims that internal mitigation with the use of experienced subcontractors and suppliers to project performance was ranked first (with a mean score value of 3.446), followed by frequent project meetings to project performance (3.391) second, proper project planning and scheduling to project performance (3.370) third, and site quality management system to project performance (3.359) ranking forth. Respondents tended to agree that the use of experienced subcontractors and suppliers to project performance to some extent is an active mitigation measure against the occurrences of NVAAs, since the mean score is 3. However, respondents also agree that clear information & communication channels to project performance, effective strategic planning to project performance ranked ninth, and effective site management & supervision to project performance, proper emphasis

on experience to project performance and training programmes for site management staff to project performance can be near minor to some extent, as their mean scores are 3.

Table 4.9 presents the analysis of external mitigation measures against the occurrence of NVAAs. The analysis reveals that respondent claims that site inspection and audits to project performance had a mean score of 3.239, ranking first, followed by regular safety meetings to project performance with a mean score of 3.163, ranking second, with Town Planning Authorities control to project performance ranking third (with a mean score of 3.163) and Standard Organization control to project performance ranking fourth (with a mean score of 3.141). Analysis further shows that respondents tend to agree that site inspection and audits to project performance, to some extent, is the most common external mitigation measure against the occurrence of NVAAs, since the mean score is 3. On the other hand, quality control monitoring and enforcement team to project performance and intervention of Nigerian Society of Engineers control to project performance is near minor, since the mean score value is 3.

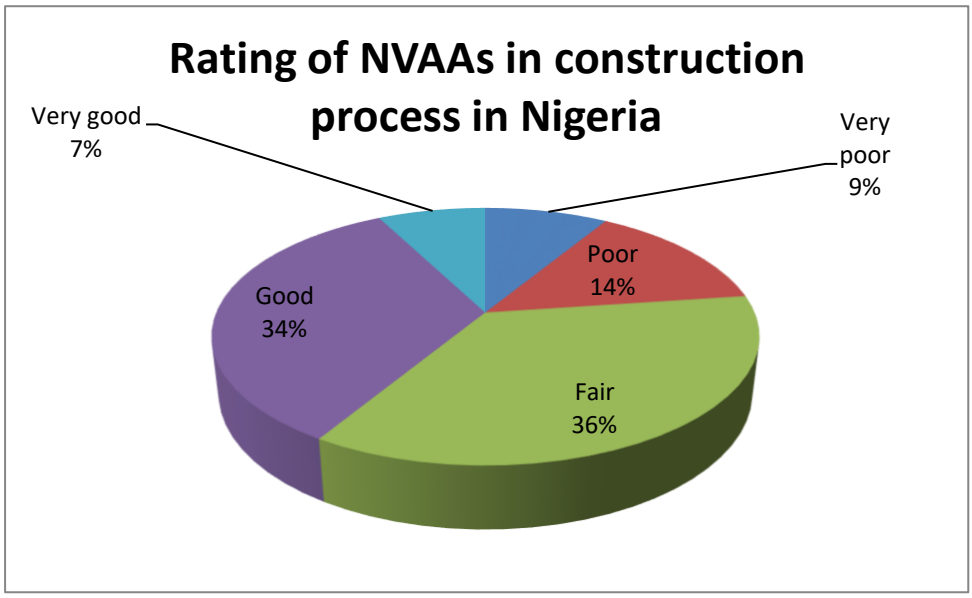

Figure 4.5: Perception on NVAA occurrence in construction projects in Nigeria

Table 4.9: Mitigating measures against the occurrence of NVAAs

Mitigation of NVAAs	Frequency (Percent) Strongly disagree	Disagree	Agree	Strongly agree	Absolutely agree	Mean	Std. Deviation	Ranking
Internal mitigation								
Use of Experienced Subcontractors & Suppliers to project performance	12.0	15.2	17.4	27.2	28.3	3.446	1.362	1
Frequent project meetings to project performance	12.0	12.0	25.0	27.2	23.9	3.391	1.301	2
Proper Project planning and Scheduling to project performance	7.6	26.1	15.2	23.9	27.2	3.370	1.332	3
Site quality management system to project performance	6.5	23.9	20.7	25.0	23.9	3.359	1.263	4
Effective Strategic Planning to project performance	9.8	21.7	17.4	28.3	22.8	3.326	1.310	6
Clear Information & Communication channel to project performance	10.9	19.6	18.5	31.5	19.6	3.293	1.288	5
Effective site management & supervision to project performance	14.1	15.2	22.8	30.4	17.4	3.217	1.299	7
Proper emphasis on experience to project performance	14.1	22.8	19.6	23.9	19.6	3.120	1.349	8
Training programs for site management staff to project performance	16.3	16.3	23.9	28.3	15.2	3.098	1.310	9
External mitigation								
Site inspections & audits to project performance	9.8	23.9	17.4	30.4	18.5	3.239	1.278	1
Regular safety meetings to project performance	12.0	20.7	21.7	30.4	15.2	3.163	1.260	2
Town Planning Authorities control to project performance	6.5	26.1	23.9	31.5	12.0	3.163	1.141	3
Standard Organization control to project performance	12.0	20.7	26.1	23.9	17.4	3.141	1.272	4
Quality control monitoring and enforcement team to project performance	15.2	21.7	21.7	19.6	21.7	3.109	1.378	5
Intervention of Nigeria Society of Engineers control to project performance	9.8	32.6	17.4	22.8	17.4%	3.054	1.287	6

4.12 Hypothesis testing and assurance of the findings

From the findings emanating from this study, it is imperative to formulate a hypothesis through which the reliability of the mitigating factors derived from this study could curtail the occurrence of NVAAs, both from its source and its cause, within construction projects in the Nigerian construction industry, as well as globally.

Thus, the study hypothesised as follows:

Hypothesis $_1$: There is a correlation between sources of NVAAs and internal mitigating techniques.

Hypothesis $_2$: There is no correlation between causes of NVAAs and external mitigating techniques.

Further to these two null hypotheses, as alternative hypothesis was formulated:

H_o: There is no correlation relation between the mitigation techniques for the occurrence of NVAAs and sources and causes of NVAAs.

The alternative hypothesis was to guide in making decisions about acceptance or rejection of the null hypothesis.

4.12.1 Statistical testing of the hypotheses

The study utilises correlation analytical technique on SPSS to examine the relationships that exist between the variables for the purpose of validating the reliability of the mitigation techniques in curbing the occurrence of NVAAs on construction projects. To test these hypotheses, correlation analysis between sources of NVAAs and mitigation techniques that were identified and ascertained in this study were conducted and presented in Table 4.10. The results of the correlations show that there is significant relationship between the sources of NVAAs and the mitigation strategies. The correlation among the variables shows the correlation coefficient ranges from 0.089 to 0.326 in absolute values. According to Pallant's (2012:133) categorisation – one (Perfect), 0.7 - 0.9 (Strong), 0.4 - 0.6 (Moderate), 0.1 - 0.3 (Weak), and 0 (zero) – the higher the correlation coefficient, the stronger the relationship. Therefore, it can be inferred that the result cut across strong and moderate positive relationships. These, then, affirmed the reliability of the findings of this study that there is significant positive relationship between the internal mitigating techniques and sources of NVAAs. Therefore, the null hypothesis is accepted and alternate hypothesis rejected.

Table 4.10: Correlation analysis results confirming the reliability of mitigation techniques

			Mitigation techniques		
			Use of Experienced Subcontractors & Suppliers	Proper Project planning and Scheduling	Frequent project meetings
Spearman's rho	Poor Coordination of Materials on Site as a source of NVAAs on construction projects	Correlation Coefficient	.326**	.168	.089
		Sig. (2-tailed)	.001	.110	.401
		N	92	92	92

**. Correlation is significant at the 0.01 level (2-tailed)

In addition, correlation analysis between causes of NVAAs and external mitigation techniques identified in this study was conducted and displayed in Table 4.11. The results of the correlations show that there is significant relationship between the causes of NVAAs and the external mitigation strategies. The correlation among the variables shows the correlation coefficient range from 0.165 to 0.396 in absolute values. The correlation coefficient showed stronger to moderate positive relationships; this, then, affirmed the reliability of the findings of this study. Thus, the null hypothesis that there is significant relationship between causes of NVAAs and external mitigating techniques is accepted and the alternate hypothesis rejected.

Table 4.11: Correlation analysis confirming the reliability of external mitigation strategies

	Causes of NVAAs		External mitigation strategies		
			Effective Strategic Planning	Clear Information & Communication channel	Effective site management & supervision
Spearman's rho	Inadequate Construction Techniques by Site Mgt	Correlation Coefficient	.379**	.321**	.326**
		Sig. (2-tailed)	.000	.002	.002
		N	92	92	92
	lack of appropriate Personnel Management skill by Site Mgt.	Correlation Coefficient	.378**	.323**	.396**
		Sig. (2-tailed)	.000	.002	.000
		N	92	92	92
	Poor ability to coordinate available resources	Correlation Coefficient	.253*	.165	.318**
		Sig. (2-tailed)	.015	.116	.002
		N	92	92	92

**. Correlation is significant at the 0.01 level (2-tailed)

*. Correlation is significant at the 0.05 level (2-tailed)

4.13 Discussion of findings in the context of the literature review

As revealed from the survey and questionnaires administered, respondents claim that lack of local skilled workers in the Nigerian construction industry in Lagos is one of the largest problems confronting the construction industry. Consequently, many of the larger firms recruit skilled workers from elsewhere to fill this caused by amateurish workers, absence of legitimate supervision, sub-standard subcontractor work force, and inexperienced site supervisors leading to poor planning, poor dissemination of information, inadequate coordination between construction professionals, slowness in making decisions, poor scheduling, and poor coordination among project participants. This occurs because of poorly filled professional roles.

Poor professional roles, as seen from the claims, also leads to the problem of the site documentation system not well-integrated, ambiguous specifications, delays in revision and redistribution of construction drawings, design changes, and low quality design and construction drawings. Frequent design changes are one of the main contributors of waste generation. The waste arises during construction due to the changes made by the clients, whether during project process or near project completion. Interviewees revealed that design changes are usually the result of owners' demands or clients' requests for changes to design, with changing requirements and preferences. Moreover, design changes can be caused by problems in material acquisition, and even unforeseen circumstances.

Analysis from the administered questionnaires further shows that incomplete drawings/design at the time of tender was the highest ranked. Also, respondents claim that wrong material storage and poor materials handling are both critical causes of waste generation. From the pilot survey, however, responses to the interview showed that few material management systems are presently effective in the construction industry. The respondents affirm that waiting for materials not only comprise waiting for material deliveries to site by materials suppliers, but also waiting for material deliveries from storage on site to certain areas of the construction site. According to one of the site managers, proper site layout is essential and thus should be designed appropriately to facilitate the flow of materials without any form of interruption. The site manager further opined that this mechanism will assist in reducing the waiting time for materials to a large extent during the construction phase.

Additionally, findings extracted from the administered questionnaires indicate that respondents tended to agree to some extent, that delay in material transportation contributed to NVAAs, with analysis determining that poor ability to coordinate available resources was ranked first, thus leading to NVAAs. From the results of administered questionnaires,

respondents were in agreement that poor site set up (plants and equipment wrongly located) by site management, ranked first.

Interview analysis showed that workers, and idleness of workmen due to poor work sequencing, was ranked first on site during operation as a key NVAA. This type of waste occurs because of inaccurate construction methods, lack of construction apparatus, ill-informed collection of equipment, unstable equipment, and poor site layout. Unskilled workers tend to make more mistakes due to lack of skills and poor working attitudes.

From the pilot survey, respondents claim that poor contract practice could be attributed to the way contracts are awarded. In most cases, projects are awarded to the lowest bidder Some of these low bidders, though, may lack management skills and have less regard for contract plans, cost control, overall site management and intelligent resource allocation. This was evident from the responses on questionnaires showing respondents were of the opinion that poor communication systems between contractor and client ranked first as a major source of NVAAs. Analysis further proved that idleness of workmen due to poor work sequencing was ranked first. As for work flow processes, claims show that construction work flow consists of a great deal of non-value adding activities consuming a high percentage of overall working time. From the analysis on effect of overtime in organisations, respondent claims show that effect of variation was ranked first.

Quality had been a measure of employees' affective responses to working and living in organisational systems. The survey showed that the management focus is on insuring that employees are satisfied, safe, and secure so as to work in conformance with specifications. Also, interviewees pointed out that there are techniques for quality control among which are education and training, testing and measurement of work done, improved craftsmanship, improved employee-management relationships, and stronger prequalification criteria. Responses from questionnaire analysis of the effect of NVAAs on project performance showed the effect of quality of work done was ranked first.

According to the site manager and site engineers, lack of trade skills is still a managerial problem to contractors, prohibiting the completion of projects satisfactorily. In fact, observations proved that 'skilled' operators were often not actually skilful, having gained their experience on the job site, learning construction skills through trial and error.

Analysis on mitigation measures against the occurrence of NVAAs was done, with respondents claiming that internal mitigation with the use of experienced subcontractors and suppliers to project performance was ranked first. In addition, the analysis of the external

mitigation measures against the occurrence of NVAAs, according to respondent claims, shows that site inspection and audits to project performance was ranked first.

4.14 Chapter summary

This chapter presents analysis of data, explaining the process followed during the data gathering exercise, the presentation of subsequent results and the discussion of findings. The data collected were analysed using the Statistical Package for Social Sciences (SPSS) software, version 24. The survey questions were designed using the 5-point Likert scale, with results of analysis ranked using mean score values. Although the survey response was low, the number of respondents was sufficient (115 respondents out of 250 questionnaires distributed) to generate a meaningful result as required for computing statistical analysis. Also, the obtained demographic information of respondents, such as gender, qualification and experience, showed respondents had sufficient experience in the construction industry and were knowledgeable in terms of the subject matter to warrant analysis. The analysis showed that respondents handled more new building projects, of which 19.6% were buildings for administration purposes, and 17.4% were residential. Frequency analysis of cost, time and size of project was done, with results showing that 17.4% had above 200 million naira as the original tender for some of projects handled by respondents, and 18.5% had above 200 million naira as the final cost of the project executed.

Analysis on the period of project showed that 38% of the respondents handled projects which had a contract period of less than 12 month; while 37% of them had less than 24 months as the actual construction period of project handled. The sources of NVAAs in building projects were analysed and results presented with 5-point Likert scale, with results ranked by mean score value. The purpose of the ranking was to identify the major sources of NVAAs on construction projects handled by respondents. Analysis on the causes of NVAAs on building projects was also done, revealing the lack of competency of site management personnel to be among other major causes, as presented in the study.

Effects of NVAAs on project performance was analysed using descriptive analysis, revealing the highest ranked and mean score values of the enumerated effects on the study. Analysis on the reliability of the research scale questions was done with the use of Cronbach's alpha co-efficient and basic assumptions pointed out respectively. Analysis on internal and external mitigation measures against the occurrence of NVAAs was done, with mean score values and the highest ranking presented according to the responses. The reliability of the mitigating factors was derived by the formulation of a hypothesis contingent upon the findings emanating

from the study, specifically to ascertain if the occurrence of NVAAs, from both its source and cause, could be curtailed.

CHAPTER FIVE
CONCLUSIONS AND RECOMMENDATIONS

5.1 Introduction

Data derived from the quantitative and qualitative survey on this – the 'identification of non-value adding activities associated with site management in the Nigerian construction industry' – were analysed and discussed. Conclusions were drawn and recommendations offered based on the obtained results. This study intended to identify the NVAAs generated related to site management, specifically in the Nigerian construction industry.

Identification of NVAAs is the best as it is by far the most economical intervention of the various waste management alternatives (Gavilan & Bernold, 1994:537). To implement an efficient waste reduction programme in the construction industry, it is necessary to identify precisely what is generating waste. As established at the beginning of this study, the objectives of this study were to determine the following: the extent to which the material management process contributes to the occurrence of NVAAs; the extent to which the site layout contributes to the occurrence of NVAAs; to identify whether or not site management personnel have adequate competency to minimise the occurrence of NVAAs; and to assess the impact of NVAAs on construction site management performance. To accomplish this goal, construction companies responded to questionnaires, with gathered data subsequently analysed. Ultimately, guidelines to reduce NVAAs have been recommended based on these findings.

5.2 Limitation

This study was conducted in Lagos, Nigeria. The collection of data from construction professionals was a challenging task, needless to say. This was because of the busy schedules of selected respondents. Complaints arose from respondents concerning tight schedules on site, attendance at contract meetings and pressures on them to meet certain project completion times, all of which led to many being unable to complete and return the questionnaires by the promised time. Some opted to not participate in the survey because of personal security reasons and others due to pending targets that took priority. Because of time constraints, a significant number of the questionnaires were returned incomplete and therefore discarded by the researcher. Hence, the findings from this study cannot be generalised in the context of NVAAs in other cities or provinces of Nigeria.

5.3 Validity assurance of the quantitative research results

This section was conducted to assess the authenticity of the quantitative data obtained by the questionnaire survey. Basically, the validity assurance of research result shows the level of applicability of the obtained results in the field of study. Thomas and Magilvy (2011:7) confirmed that the validity of research is the level to which the data obtained evaluates accurately that which it was intended to evaluate. To ensure that the research results are valid and reliable, the following steps were considered:

I. *Research population:* The population sampled for this study was comprised of construction stakeholders (architects, site engineers, site managers and contractors) in the construction industry in Lagos, Nigeria.

ii. *Expected participants:* Experienced construction stakeholders within the industry were the targets.

iii. *Sampling technique:* The cluster sampling method was adopted for data collection in this study, as the cluster sampling method redistributes the target population (with high concentration of construction companies and experienced professionals) into smaller groups (clusters) from which samples are randomly selected for data collection and result generalization.

iv. *Time:* The data were collected within a considerable time limit of four months.

v. *Data collection instrument:* The most accurate data collection tool was adopted for each phase of collection.

vi. *Exploratory/pilot study:* The exploratory study was conducted to determine the reliability and accuracy of the data collection method to be adopted for the main study.

vii. *Interview sessions:* The interview sessions with the respondents were recorded using an iPhone recorder.

5.4 Achieving the objectives of the research study

Objective one of this study was to identify the sources of NVAAs during Nigerian construction projects. In achieving this objective, the data collected were analysed and major findings centred on the way improper planning for construction operation related to material management processes leading to material waste; how material management processes contribute to the occurrence of waste on site; and how site layout affects the movement of men, equipment and materials on site, thereby leading to the occurrence of waste. The

findings showed that poor site management and supervision, primarily due to lack of experience, was the major source of non-value adding activities on building construction projects. In addition, policies on selection of site managers and supervision should be enforced in every construction project as a means of generating awareness for identifying possible occurrences of NVAAs, as only after clear identification can the occurrence of NVAAs be alleviated. There should be a proper plan for weekly and daily activities which should be followed thoroughly and amicably.

Objective two of this study was to determine the causes of the occurrences of NVAAs. The findings revealed that the causes are poor ability to coordinate available resources, and lack of appropriate personnel management skill by site management teams. In addition, inadequate construction techniques by site management caused NVAAs, and the lack of competency of site management personnel contributed to the causes of NVAAs. The findings also revealed that poor site layout affected the delivery of materials on site, thereby affecting the subsequent line of work and increasing the time of work and project delivery.

Objective three was to ascertain the effects of occurrences of NVAAs on management of personnel on construction sites. The findings reveal that the effect of NVAAs on quality of work done influenced project execution and impacted project performance. Results tended to be in agreement that site set up influences NVAAs to some extent. Further to this inference, this study reveals that variation, disruption to regular progress of work, and inexperienced site manager and supervisors contribute most to defective works and reworks in the Nigerian constriction industry. Attention must therefore be placed on the selection process of competent field supervisors, with proper training to enlighten staff on identifying the occurrences of NVAAs during operation.

Objective four was to develop techniques to mitigate effects of NVAAs on construction projects. To achieve the objective, data was sought which centred on the impact relative to time, cost and quality. The findings reveal that mitigation measures against the occurrence of NVAAs internally include the employment of experienced subcontractors and suppliers, frequent project meetings, proper project planning and streamlined scheduling. The results affirmed that the involvement of experienced subcontractors and suppliers is a proactive mitigation measure against the occurrences of NVAAs. Moreover, clear information and communication channels, effective strategic planning, and effective site management and supervision were the external mitigation techniques. Thus, the novel framework for the mitigation of NVAAs in construction projects is represented in Figure 5.1.

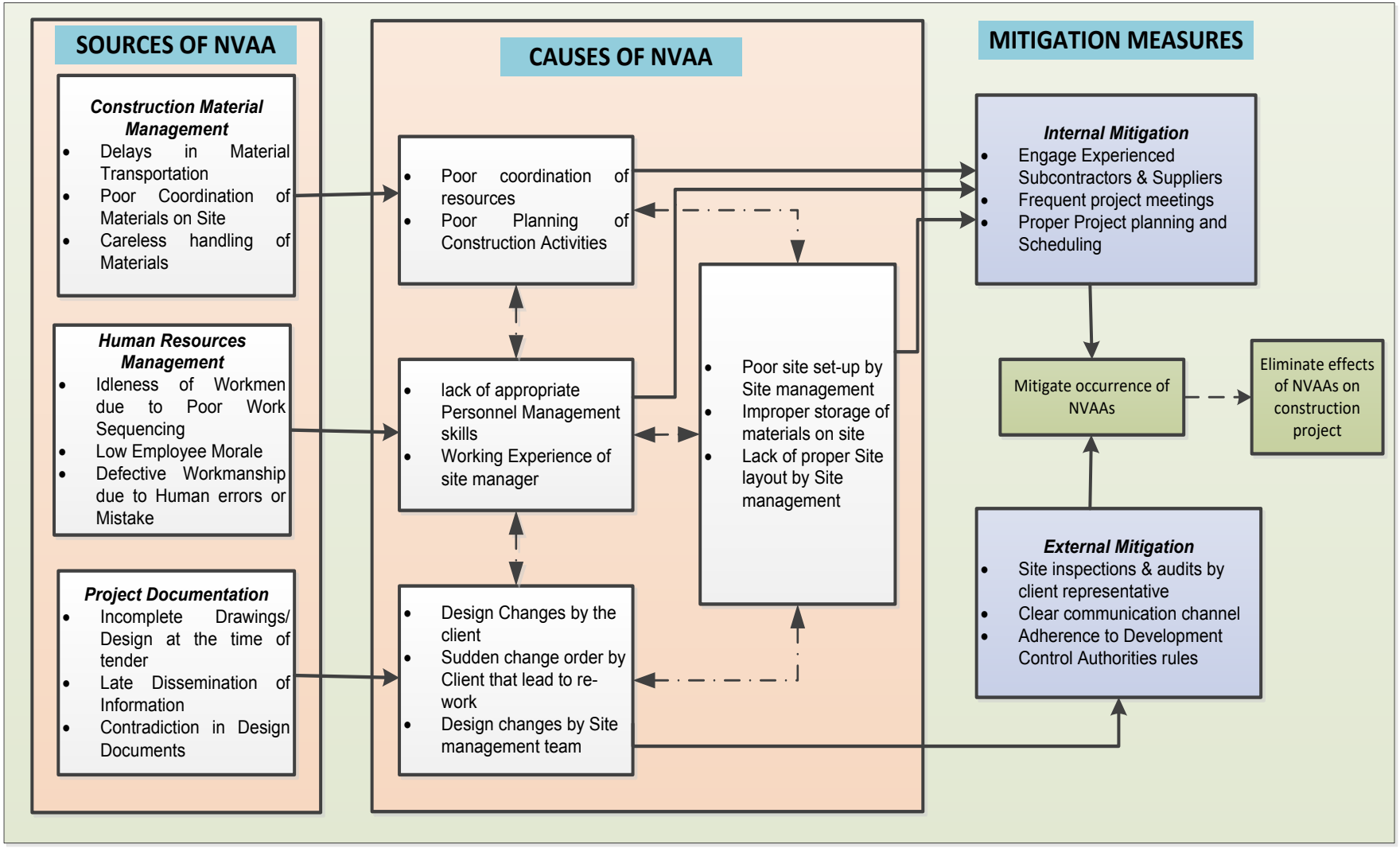

Figure 5.1: Framework for mitigation of NVAAs in construction projects

5.5 Conclusion

The adoption of these findings by construction professionals in the Nigerian construction industry during building construction would enhance the delivery of structures whose process of construction and life cycle of operation will promote health and well-being of the inhabitants and environmental balance, all at reduced cost, at the time stipulated, and to the expected quality. Considering the objectives of this study, factors were discussed and achieved.

It was evident from the findings that management of construction projects depends entirely on the competence of key project stakeholders in the construction industry. Thus, assigning construction project management responsibilities to appropriately skilled internal experts will assist to a very large extent in forecasting and identifying client-induced NVAAs prior to and during the execution of construction activities on site. In addition, consultants should rather engage competent personnel to sign-off work regarding project performance than rely on fresh graduates who are inexperience to perform that particular task. Furthermore, construction firms should focus on continuous professional development of their existing staff, as well as empowering new recruits with appropriate built environment qualifications to enable them take-up the challenging roles within the industry, particularly, the ability to forecast and detect the sources of NVAAs during construction project.

Another significant issue emerging from the findings was time overruns, which are likely influenced by the impact of NVAAs on project time. This result was similar to the ones reported in the construction management literature. More so, it was evident from the survey and the review of literature that the detrimental effects of NVAAs including design related rework, lack of required competencies and sluggish supervision on site could be minimised to enhance project performance in the construction industry. These suggestions originated from the evidence that the lack of appropriate skilled workers and managerial incompetence would likely influence the prevalence of NVAAs, which subsequently exacerbates the poor performances recorded in the Nigerian construction industry.

5.6 Recommendations

Early identification of the root causes of NVAAs would certainly provide a useful information for project stakeholders to design a suitable containment strategy to minimise / prevent the occurrences of waste. Conducting workshops for project team members on a regular basis concerning lean design management approach will also assist in reducing the incidence of NVAAs on site. Hence, the effective implementation of appropriate methodology for lean construction principles at an early stage of the construction project, may minimise non-value adding activities during construction. By understanding the penalties associated with the

incidence of non-value adding activities, all projects stakeholders will be able to perform their roles as facilitators in a concise, clear and comprehensive manner in order to ensure the elimination of non-value adding activities. Further research should focus on the holistic barriers to the awareness of NVAAs, and developing of a universal implementation framework that can fit into any construction environment. Additional research also should be made into the adoption of other lean construction tools and techniques within the Nigerian construction industry, and perhaps beyond as well. Further research should be developed to address the research limitations highlighted in this particular project. Although the framework developed in this research facilitates the identification of NVAAs in the Nigerian construction industry, a tool kit and implementation guide would be a helpful development for further assisting in the practical limitation of NVAAs created on site.

The following recommendations for future studies are relevant and related to this research:

- A similar study with wider sample size and with a wider sample type should be conducted, focusing specifically on building construction companies outside Lagos and comparing the findings with the outcome of this research.

- Apply the concepts and the recommendations established in this study into building construction sites to verify their advantages of the reduction of NVAAs and consequently, the high cost of waste.

- Conduct a similar study with other segments in the construction industry to determine which waste categories are most strongly affecting the industry in these segments, the types of waste occurring in these categories, and the causes of the waste. From this, new recommendations can be offered for reducing NVAAs and related costs.

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APPENDIX A

SEMI STRUCTURED QUESTIONNAIRE FOR THE EXPLORATORY STUDY

SECTION A: CAUSES OF NVAAs

Material management process

1. In which way does improper planning for construction operation related to material management process leads to material waste?
2. What are your challenges in terms of material management process on site?
3. How does site layout affect the movement of;
    a. Men?
    b. Equipment?
    c. Material on site?
4. How does the time and programme of your site activities contribute to NVAAs?

SECTION B: IMPACT OF NVAAs

1. What are the impact/effect of waste/NVAAs on the output of construction process in terms of:
    a. Time?
    b. Cost?
    c. Quality?

SECTION C: MINIMISING THE OCCURRENCE OF NVAAs

Human resource capability

1. What is the level of competency of site management personnel towards minimising the occurrence of waste on site?
2. What are the training programmes in place for your employees to know the importance of waste minimisation on site?
3. What criteria do you use in employing both skilled and semi-skilled workers on site?
4. How often do artisans get supervised during site activities to help in eliminating waste?
5. What are the modalities in setting up your site to allow proper flow of materials, men and equipment to avoid unnecessary time waste and material wastage?
6. What are the modalities in place to ensure proper dissemination of information and documentation on site to save time and prevent a lack of information?

Efficiency of mitigation measures

1. What strategies do you have in place to control/prevent the occurrence of waste/NVAAs on construction site?
2. How do these mitigation strategies help to minimise the occurrence of waste in construction process?

Quality management issues on site

1. What are the systems in place to check the quality of work on site?
2. How do you ensure that materials selected conform to the contract specification?
3. How does site layout contribute to effective flow of men and equipment to prevent NVAAs/waste?
4. What are the systems in place to undertake site inspections, reviews and audits prior to issuing out of duties on site?
5. What are the processes you use in check-mating to ensure that intended daily activities are executed effectively, as planned?

APPENDIX B

QUESTIONNAIRE FOR THE STUDY

THE IDENTIFICATION OF NON-VALUE ADDING ACTIVITIES ASSOCIATED WITH SITE MANAGEMENT IN THE NIGERIAN CONSTRUCTION INDUSTRY

Dear Sir/Madam,

PARTICIPATION IN A SURVEY

You are invited to be a participant in this research survey which aims at identifying the incidence of non-value adding activities associated with site management in the Nigerian construction industry. This study is primarily undertaken for **academic purposes** for a Master of Technology degree in Construction Management.

In the context of the study, non-value adding activities (also called waste) are any "activity that takes time, resources or space but does not add value". Non-value adding activity (waste) is also defined as "any losses produced by activities that generate direct or indirect costs but do not add any value to the product from the point of view of the client".

Therefore, "if the most important influencing factors in any contracting organisation are identified, measures can then be taken to apply them to upgrade the contractor's performance". The study is limited to site management, taking cognizance of material management, site layout and the competency of site personnel: the higher the knowledge and awareness of non-value adding activities associated with site management, the greater the prospect of avoiding them and consequently helping in the reduction of construction delivery cost.

All information provided in this study will be kept strictly **CONFIDENTIAL.**

Kindly complete the survey and return to:

DON-WILLIAM OSILUAMHE IMIMOLE

E-mail: donimimole@gmail.com or 215180291@mycput.ac.za

Department of Construction Management and Quantity Surveying

Mobile: +27 (74) 258 6291

Thanks for your cooperation and readiness to assist always

Cape Peninsula
University of Technology

CONSENT FORM

Please tick as appropriate

1. I am aware that the information required by the researcher in this study is perceived as an opportunity to contribute towards identification of non-value adding activities in the construction industry. ☐

2. I understand my participation is voluntary and that I am permitted to withdraw at any point in the survey. ☐

3. I hereby endorse my participation in the research survey ☐

Date. . . . . **Signature** . . . . . .

QUESTIONNAIRE

SECTION A: 1. BIOGRAPHICAL INFORMATION OF PARTICIPANTS

1.1 Kindly indicate your gender:

☐ Male ☐ Female

1.2 Please indicate the sector your company belongs to in the construction industry:

☐ Private ☐ Public ☐ Both

1.3 Please indicate your years of experience in the construction industry:

☐ 0 – 5 years ☐ 6 - 10 years ☐ 11 – 15 years ☐ 16 years and above

1.4 Please indicate your current position in your company:

☐ Site manager ☐ Site supervisor ☐ Project manager ☐ Director

☐ Architect ☐ Site Engineer ☐ Estimator / QS

Other (please specify) ……

1.5 Please indicate your level of formal education:

☐ SSCE Certificate ☐ National Diploma (ND) ☐ Higher National Diploma (HND)

☐ BSc Degree ☐ BSc Honours ☐ MSc Degree ☐ Doctoral Degree

Other (please specify) ……

SECTION B: 2. PROJECT CHARACTERISTICS

Response in this questionnaire will be based on a project you have personally been involved with:

2.1 Response in this questionnaire will be based on a project you have personally been involved with: what was the project type?

☐ New Build ☐ Refurbishment/Renovation

Other (please specify) ……

2.2 What is the facility type that best describes the project?

☐ Administrative ☐ Banks ☐ Educational

☐ Entertainment ☐ Hospitals/Health ☐ Commercial

☐ Hotel/Motel/Resort ☐ Industrial ☐ Residential

Other (please specify) ……

2.3 How much was the original tender sum? _____

2.4 How much was the final contract sum? _____

2.5 What was the project's original construction period? _____

2.6 What was the project's actual construction period? _____

2.7 What was the project's gross floor area (m^2)? _____

2.8 How many floors did the project have? _____

SECTION C: 3. SOURCES OF NON-VALUE ADDING ACTIVITIES (NVAAs)

On a scale of 1(minor) to 5(major), kindly rate the level of contribution of the following sources of NVAAs on construction projects (Please note the 'Unsure' option).

3.1	**Flow of materials**	**Minor……. Major**					
3.1.1	Inappropriate storage of building materials	1	2	3	4	5	U
3.1.2	Aggressive handling of materials (example, bricks and blocks during construction leading to cracks and spoil)	1	2	3	4	5	U
3.1.3	Unnecessary material handling	1	2	3	4	5	U
3.1.4	Delays in material transportation / delivery	1	2	3	4	5	U
3.1.5	Excess materials on site	1	2	3	4	5	U
3.1.6	Lack of control of material distribution for work	1	2	3	4	5	U
3.1.7	Defective materials on site because of poor sequencing	1	2	3	4	5	U
3.1.8	Materials not in right place when needed	1	2	3	4	5	U
3.1.9	Defective materials on site because of poor transporting system	1	2	3	4	5	U
3.2	**Work of men**	**1**	**2**	**3**	**4**	**5**	**U**
3.2.1	Lack of required competencies of construction workers	1	2	3	4	5	U
3.2.2	Inadequate supervision on site	1	2	3	4	5	U
3.2.3	Low employee morale	1	2	3	4	5	U
3.2.4	Idleness of workmen on site because of poor work sequencing	1	2	3	4	5	U
3.2.5	Poor workmanship due to human errors or mistakes	1	2	3	4	5	U
3.2.6	Defective materials on site due to human errors	1	2	3	4	5	U
3.2.7	Clash of time during work execution by workers	1	2	3	4	5	U
3.2.8	Inadequate trade skills	1	2	3	4	5	U
3.2.9	Poor distribution of labour	1	2	3	4	5	U
3.2.10	Late supervision of work	1	2	3	4	5	U
3.2.11	Shortage of skilled supervisors/foremen	1	2	3	4	5	U
3.2.12	Inadequate subcontractor's skills	1	2	3	4	5	U
3.2.13	Poor planning of work	1	2	3	4	5	U
3.2.14	Poor working schedule	1	2	3	4	5	U
3.3	**Information and documentation**	**1**	**2**	**3**	**4**	**5**	**U**
3.3.1	Errors in material specification	1	2	3	4	5	U
3.3.2	Contradiction in design documentation	1	2	3	4	5	U

3.3.3	Unrealistic project execution plans	1	2	3	4	5	U
3.3.4	Incomplete drawings / design at the time of tender	1	2	3	4	5	U
3.3.5	Late dissemination of information	1	2	3	4	5	U
3.3.6	Unclear design details in drawings	1	2	3	4	5	U
3.3.7	Omission of item(s) from the contract documentation	1	2	3	4	5	U
3.3.8	Inadequate design details in drawings	1	2	3	4	5	U
3.3.9	Poor information management	1	2	3	4	5	U
3.3.10	Poor quality site documentation	1	2	3	4	5	U
3.3.11	Slow response to request for information	1	2	3	4	5	U

SECTION D: 4 CAUSES OF NON-VALUE ADDING ACTIVITIES (NVAAs)

On a scale of 1(minor) to 5(major), to what extent do the following causes of NVAAs contribute to poor project performance (please note the 'Unsure' option)?

4.1	**Competency of site management personnel**	**1**	**2**	**3**	**4**	**5**	**U**
4.1.1	Poor decision making ability	1	2	3	4	5	U
4.1.2	Lack of leadership ability	1	2	3	4	5	U
4.1.3	Lack of appropriate skilled site management personnel	1	2	3	4	5	U
4.1.4	Poor planning of construction activities	1	2	3	4	5	U
4.1.5	Lack of working experience	1	2	3	4	5	U
4.1.6	Lack of safety measures on site	1	2	3	4	5	U
4.1.7	Poor ability to coordinate available resources	1	2	3	4	5	U
4.1.8	ineffective management of project team	1	2	3	4	5	U
4.1.9	Poor site management personal leading to productivity loss	1	2	3	4	5	U
4.1.10	Unclear instruction to workers	1	2	3	4	5	U
4.1.11	Lack of quality assurance / quality control on site	1	2	3	4	5	U
4.2	**Site setup**	**1**	**2**	**3**	**4**	**5**	**U**
4.2.1	Lack of proper site layout	1	2	3	4	5	U
4.2.2	Inappropriate movement of materials as result of poor site set up	1	2	3	4	5	U
4.2.3	Unsuitable movement of men on site due to poor site setup	1	2	3	4	5	U
4.2.4	Inadequate working space because of non-precise site setup	1	2	3	4	5	U
4.2.5	Inappropriate positioning of storage places for material	1	2	3	4	5	U
4.2.6	Poor access to work place leading to access routing not convenient	1	2	3	4	5	U
4.2.7	Plants wrongly located due to poor site setup	1	2	3	4	5	U
4.2.8	Idleness of workers due to congestion on site	1	2	3	4	5	U
4.2.9	Working equipment wrongly located due to poor site setup	1	2	3	4	5	U
4.2.10	Unsuitable movement of equipment due to poor site setup	1	2	3	4	5	U
4.2.11	Idleness of workers due to congestion on site	1	2	3	4	5	U
4.3	**Contract practices**	1	2	3	4	5	U
4.3.1	Sudden requirement of client after contract approval leading to rework	1	2	3	4	5	U
4.3.2	Frequent design changes	1	2	3	4	5	U

4.3.3	Poor communication system between contractor and client	1	2	3	4	5	U
4.3.4	Dishonesty among parties involved in the contract	1	2	3	4	5	U
4.3.5	Unfairness among parties involved in the contract	1	2	3	4	5	U
4.3.6	Lack of cooperation on site	1	2	3	4	5	U
4.3.7	Noncompliant with all legal obligation (The rule of Law) during the contract period.	1	2	3	4	5	U
4.3.8	Conflict of interest among contractor and client because of selfish interest or personal benefit.	1	2	3	4	5	U
4.3.8	Errors because of interruption to work	1	2	3	4	5	U
4.3.10	Design errors leading to rework because of owner sudden change	1	2	3	4	5	U
4.3.11	Rework leading to additional time	1	2	3	4	5	U
4.3.12	Changes because of work interruption	1	2	3	4	5	U
4.3.13	Rework leading to addition working effort	1	2	3	4	5	U

SECTION E: 5 EFFECTS OF NON-VALUE ADDING ACTIVITIES (NVAAs)

On a scale of 1(minor), to 5(major), how will you rate the effect of NVAAs on project performance and organisation involved in the project you have selected (please note the 'Unsure' option)

5.1	**Project performance**	**1**	**2**	**3**	**4**	**5**	**U**
5.1.1	Cost overrun because of inability to meet project objectives	1	2	3	4	5	U
5.1.2	Time overrun as a result to inaccurate time estimation	1	2	3	4	5	U
5.1.3	Non-achievement of quality of work done on project delivery	1	2	3	4	5	U
5.1.4	Client dissatisfaction because of dispute between parties	1	2	3	4	5	U
5.1.5	Poor site setup leading to excessive change orders	1	2	3	4	5	U
5.1.6	Design team dissatisfaction due to non-conformance to specification on site	1	2	3	4	5	U
5.1.7	Inevitable inefficiencies associated with lack of skilled artisans	1	2	3	4	5	U
5.2	**Organization**	**1**	**2**	**3**	**4**	**5**	**U**
5.2.1	Excessive overtime because of frequent scope and design changes	1	2	3	4	5	U
5.2.2	Fatigue because of rework or repeated task	1	2	3	4	5	U
5.2.3	Time-space conflict because of improper planning	1	2	3	4	5	U
5.2.4	Time-space conflict because of improper work schedule	1	2	3	4	5	U
5.2.5	Clash / overlapping of activities due to poor site management	1	2	3	4	5	U
5.2.6	Disruption/interruption of activity sequence because of late scope and design changes	1	2	3	4	5	U
5.2.7	Additional resources allocation leading to tasks which was wrongly done the first time	1	2	3	4	5	U
5.2.8	Loss of future work because of poor project delivery	1	2	3	4	5	U
5.2.9	Variation due to frequent changes	1	2	3	4	5	U
5.2.10	Claims due to frequent changes	1	2	3	4	5	U
5.2.11	Reduced profit due to rework or repeated task	1	2	3	4	5	U

SECTION F: 6. MITIGATION OF NVAAs

On a scale of 1(strongly disagree) to 5(strongly agree), to what extent do you agree that the following mitigating measures are effective for reducing the incidence of non-value adding activities (please note the 'Unsure' option)

6.1	**Internal mitigation of NVAAs**	**1**	**2**	**3**	**4**	**5**	**U**
6.1.1	Use of experienced subcontractor	1	2	3	4	5	U
6.1.2	Site quality management system	1	2	3	4	5	U
6.1.3	Effective strategic planning	1	2	3	4	5	U
6.1.4	Proper project planning	1	2	3	4	5	U
6.1.5	Frequent project meetings	1	2	3	4	5	U
6.1.6	Proper emphasis on learning from experience	1	2	3	4	5	U
6.1.7	Clear information and communication channel	1	2	3	4	5	U
6.1.8	Training programs for site management staff	1	2	3	4	5	U
6.1.9	Effective site management	1	2	3	4	5	U
6.1.10	Proper project scheduling	1	2	3	4	5	U
6.1.11	Effective site supervision	1	2	3	4	5	U
6.2	**External mitigation of NVAAs**	**1**	**2**	**3**	**4**	**5**	**U**
6.2.1	Site inspections and audits by the government	1	2	3	4	5	U
6.2.2	Regular safety meetings with safety personnel	1	2	3	4	5	U
6.2.3	Quality Control monitoring team.	1	2	3	4	5	U
6.2.4	State and local regulations monitoring team	1	2	3	4	5	U
6.2.5	Quality control enforcement team	1	2	3	4	5	U

7. Do you have any comments in general regarding the impact of non-value adding activity management in the Nigerian construction industry?

_____
_____
_____
_____
_____
_____

8. Do you have any suggestions for an effective strategy for reducing or curtailing NVAAs on construction sites?

_____
_____
_____
_____
_____
_____

Thank you for your time!

APPENDIX C

CONFERENCE PAPER PUBLISHED DURING THE STUDY

ASOCSA2016-038

The identification of non-value adding activities on construction sites in Lagos, Nigeria

Don-William Osiluamhe Imimole1, Ruben Ndihokubwayo2, Eric Kwame Simpeh3

215180291@mycput.ac.za, ndihokubwayor@cput.ac.za, simpehe@cput.ac.za

1,2,3 Cape Peninsula University of Technology, Department of Construction Management and Quantity Surveying

1MTech student, Tel 0219598693, Mobile 0742586291

2Lecturer, Tel 0219596845, Mobile 0737215859

3Lecturer, Tel 0219596011, Mobile 0835489732

ABSTRACT

Purpose: The purpose of this study is to identify non-value adding activities (NVAAs) associated with site management in the Nigerian construction industry in Lagos as a case study.

Design: A qualitative approach was adopted with a purposive sampling whereby observations of construction activities on sites were coupled with self-administered open-ended interviews conducted with consulting engineers, site engineers, site managers and construction managers.

Findings: Three construction companies took part in the survey, with eight personnel participating in the interview. It was revealed that improper planning of construction site activities – such as material management, site layout, and the competency of site personnel – resulted in non-value adding activities; this confirms the status of poor site performance in the industry.

Limitations: The study was confined to selected building construction sites in Lagos, Nigeria. Attention was placed only on the evaluation of non-value adding activity (waste) associated with site management in the construction industry during the project execution phase.

Practical implications: The study is carried out for two reasons: 1) to assist in making suitable contributions to the understanding of NVAA management measures through the application of some important principles that have been neglected; and 2) to create awareness for construction company workers to ascertain factors that contribute to NVAAs so that they can reduce the level of waste and increase productivity during construction.
Keywords: Construction industry, management measures, Nigeria, non-value adding activities (NVAAs), site management, waste