KWAME NKRUMAH UNIVERSITY OF SCIENCE AND TECHNOLOGY

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ATTITUDE OF CONSTRUCTION WORKERS TOWARDS BUILDING MATERIAL WASTAGE

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BUILDING MATERIAL WASTAGE

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DECLARATION AND CERTIFICATION

I hereby declare that this submission is my own work towards the award of MSc Construction Management and that, to the best of my knowledge, it contains no material previously published by another person or material which has been accepted for the award of any other degree of the University, except where due acknowledgement has been made in the text.

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DEDICATION

This work is dedicated to God Almighty, my lovely wife Mrs. Millicent Kala Gandaa for her immense support throughout the period of this study and my children Ellis and Tasha.

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ABSTRACT

Construction materials form an important part of every construction project. Without them the objectives of the project cannot be realized. The management of construction materials has been problematic over the years leading to shortage of materials during construction and delay in completion of projects as a result of wanton generation of construction waste. One area of construction waste investigation which has eluded the radar of construction researchers is the attitude of construction workers towards construction waste generation. It is intended that this investigation should promote sustainable construction. In order to achieve the above aim, this study adopted a quantitative approach by using structured field survey questionnaire as the key tool for data collection which gave a response rate of 95%. The SPSS was used in packaging the data for analysis. The main technique of data analysis was descriptive statistics focusing mainly on the mean score, standard deviation, and indexes. The chi square which is a non-parametric tool was also used to ascertain the significance of result. The findings of the study indicate that construction workers have not developed sympathetic attitude towards the wastage of construction material. Attitude related factors among construction workers to material waste generation include rework due to workers mistakes/poor workmanship; poor communication among the parties involved in a project; human error and carelessness; improper interaction between engineers and workers; and provision of insufficient information to project participants among others. Similarly, the study uncovered project cost as the key aspect of construction projects severely affected by the construction waste as far as the attitude of construction workers is concerned. The most wasted materials uncovered by this study consist of mortar, cements, plaster and grouting; timber construction products; bricks and blocks; and ceramics. Key guidelines proposed for adoption to curb construction material waste include the use of bar-code system for material management for delivery and return;

use of reward system and punishment; waste audit; and issuance of certificates to construction firms for waste minimization. It is believed that this study will ignite a wind of change in the construction industry as far as construction material wastage is concerned. For instance, bar coding technology can be adopted to track the movement of construction materials from source to final placement on site. This study has the potential of fostering other studies in the future within the framework of attitude of construction workers.

Keyword: Attitude, Construction, Waste, Material, Workers, building

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CHAPTER ONE

INTRODUCTION

1.1 Background to the Study

This chapter discusses the general introduction to the study. It concentrated on key contemporary issues of waste management in the construction industry. It also considered the problem statement of the study; the research questions driving the study; and aim and objectives of the study. An overview of the methodology has also been briefly provided including the scope of the study; significance of the study; and the overall organization of the study.

Majority of waste of construction resources (materials) occurs not only due to bad workmanship, inadequate supervision, improper planning or poor organization of a site, but because of the pre-notions of the construction participants that wastage is normal part of the process. These beliefs often make construction participants exhibit a nonchalant attitude to resources utilization (Fapohunda, 2011). Waste resources (physical, solid or latent) in nature are non-value added resources (Howell 1999). That is, construction material waste adds no value to the overall outcome of a product.

These wastes occur mainly through inefficient utilization of construction materials. The occurrences of these material wastes are either intentional or unintentional, which could be avoided during construction production phase through adequate evaluation of attitude and practices of the construction workers (participants).

Over the last decade, environmental awareness has emerged as an area of concern in the construction industry (UNCHS, 1993; CIRIA, 1993; Griffith, 1995). Central to the environmental debate is a global reassessment of methods employed to manage the

substantial amount of waste produced annually by the construction industry. It has been estimated that construction waste contributes 20-30% of all waste deposited in Australian landfills and similar proportions of landfill in the US and parts of Europe and Africa (Apotheker, 1992; Craven et al., 1994; Faniran and Caban, 1998). The increase in construction waste is necessitated by the high cost of landfill site management coupled with the poor reception attitude of construction workers on waste management. However, for environmental and economic reasons, levels of waste need to be reduced significantly. Current research in waste management has focused on the quantification of waste and on identifying ways in which it can be minimized, reused, recycled or disposed of (Allessie, 1989; Apotheker, 1990; Gavilan and Bernold, 1994; Lauritzen, 1994; Bossink and Brouwers, 1996; Poon, 1997). Drawing from the above, it is imperative to conduct studies that focus on wastage management on construction site. This is evident in the work of Wilson et al. (1998). Similarly, other studies conducted earlier have suggested that significant success can be achieved by implementing waste management strategies in the construction industry (Trevorrow, 1996; Alford, 1996; Sinclair, 1996; Heino, 1994).

1.2 Problem Statement

Majority of construction wastefulness stems from pre-notion of construction operatives and managers on site that material wastage during construction is normal. This perception regarding the attitude of operatives and managers in the delivery of construction projects has led to most projects not achieving value for money. In spite of the fact that many have explored this area as far as construction research is concerned, there exist a gap as far as studies exploring the attitude of operatives are concerned. Material wastage during construction has the potential of creating shortage. This leads to the use of substandard materials which can adversely affect the quality

of the work produced. However, the labour-intensive nature of construction activity suggests that attitudinal impediments are likely to influence waste levels . While some research has been conducted on how existing work processes contribute to waste, this viewpoint is insufficient to tackle the problem, hence the need for this research study.

1.3 Research Questions

The following research questions are set to drive the conduct of the study:

1. What are the attitudes of constructction workers towards material waste?
2. What factors encourage construction workers attitude towards material waste?
3. What are the key aspects of construction projects mostly affected by material waste?
4. What are the most wasted materials through the attitude of construction wrokers?
5. What ways could be used to promote positive attitudinal change in construction workers as far as material waste is concerned?

1.4 Aim and Objectives of the Study

1.4.1 Aim of the Study

The main aim of this study is to investigate the attitude of construction workers toward construction material wastage. It is intended that this investigation should contribute to sustainable construction.

1.4.2 Objectives of the Study

The following specific objectives were set for the conduct of the study:

1. Identify the attitudes of construction workers towards material wastage;
2. Determine factors that encourage construction workers attitudes towards material wastage;

3. Uncover the key aspects of construction projects mostly affected by material wastage;
4. Identify construction material mostly wasted through attitude of construction workers; and
5. Propose ways for promoting positive attitudinal change among construction workers as far as material wastage is concerned.

1.5 Scope of the Study

This research was limited to building professionals in building consultancy services with particular reference to Architects, Quantity Surveyors, Civil Engineers and construction workers of building construction firms with particular reference to site project managers, site supervisors, masons, steel benders, carpenters and other related construction professionals who contributes their services in construction projects, mostly practicing in the Tamale Metropolis of the Northern Region of Ghana and registered with the Ministry of Water Resources, Works and Housing (MWRWH) in the categories of D1K1 and D2K2 classifications.

1.6 Research Methodology

Quantitative approach was adopted for the conduct of this study. A survey was therefore to be conducted using survey questionnaires to collect data from respondents. Respondents were selected by simple random sampling to avoid bias. The statistical packages for social sciences(SPSS) was used in packaging the data collected for the analysis upon which key statistical tools were deployed for the analysis of the data. The statistical tools for the data analysis were mainly descriptive comprising of the mean score, standard deviation and indexes. Non-parametric tool was also used, in which case the chi square was used to test for significance of results.

1.7 Significance of the Study

This study is expected to address the operative‟s attitude to work, practices in resources wastefulness and utilization, the motivation toward averting wastage, and best approaches to resources waste management on sites. This research will identify the behavioral features of site participants on construction material wastefulness and will provide a framework for achieving efficient utilization of construction resources; which include self-fulfillment, belongingness and regular appraisal. The issues concerning the management and the employees towards achieving efficient resources utilization will equally be identified.

Levels of waste within the construction industry need to be reduced for environmental and economic reasons. Changing people‟s wasteful attitude behaviour can make a significant contribution. This research project investigates the attitudinal forces that will shape behaviour at the operative level. Waste management is perceived as a low project priority, and there is an absence of appropriate resources and incentives to support it.

The outcome of this study is expected to support attitudinal change among construction operatives towards material wastage. This will subsequently reduce the amount of waste generated by the construction industry to ensure improvement in environmental systems, they may reduce costs overrun arising from wastage on construction site.

1.8 Organization of the Study

The first chapter of the research contains the introduction to the research. Sections within this chapter include problem statement, purpose of the study, aims and objectives of the study, research methodology as well as scope of the study. An overview of the Ghanaian construction industry and the concept of construction material management is undertaken in chapter two. This chapter focus on literature on the elements and

activities in the Ghanaian construction industry environment as well as the concept of construction operative‟s attitude towards materials wastage on construction sites. The research methodology is described in the third chapter of the work. Details like type of data to collect, data collection tools and data analysis tools are discussed here. Chapter four of the research contains data collected and the analysis. Information obtained from the analysis of the data collected is discussed in this chapter. Conclusions and recommendations on the research are contained in chapter five of the research. Proposals for the adoption of good construction materials management principles and recommendations for future implementation is equally discussed in this chapter.

CHAPTER TWO

LITERATURE REVIEW

2.1 Conceptualization of Attitude

Attitudes in research especially within the domain of social psychology have studied (Lind, 1984; and Kelman, 1974). Attitude is conceptualized in two main aspects notably the affective and cognitive aspects (Lind, 1984). The cognitive aspect is a conscious awareness of the linkage between an object and its value. The affective aspect of attitude is related to the level of value attached objectives for instance construction materials by operatives The tendency to waste the material represents the behavioural aspect of attitude (see for instance Chaiklin, 2011). The aspect which is knowledge and the affective aspect which is relational are important in material management during construction operations. This is because the knowledge of construction operatives will affect the manner in which they handle materials on site which consequently will

determine the rate of wastage. Similarly, within the affective aspect of human attitude, the relation of operative to material by the dictates of their hearts will affect the amount of materials that will be wasted.

Over the years researchers have given various forms of definitions to the term attitude(*see for instance* Thurstone, 1931; Allport, 1935; Rosenberg & Hovland, 1963; Campbell, 1950; Newcomb, 1959; Campbell *et al*., 1963; Fishbein & Ajzen, 1975; and Meinefeld, 1977). According to Lind (1984), attitude is the degree of positive or negative effect consistently associated with a person's response to a welldefined class of psychological objects. Other key terms or phrases for attitude over the years include a mental and neural state (Allport, 1935); a system of two or more beliefs held by an individual (Campbell et al., 1963); belief systems as a configuration of ideas (Converse, 1970). Newcomb (1959) considered attitude as the „orientation" which is the existing organization of the psychological processes within an individual. This definition of Newcomb is apt as far as this research agenda is concerned in the sense that the orientation of construction operatives mainly affect the rate of material wastage on site(Pekuri *et al*, 2011). Drawing on from this definition, construction managers are to take a cue and orient operatives on site towards the management of construction materials. Hence orientation can be organized for operatives or all the workers on a particular construction site before the commencement of construction activities on site.

In defining attitude, Lind (1984) identified three main properties of the concept. These include direction considered as positive or negative effects; magnitude effects; and consistency of reaction. According to Kelman (1974) attitudes are integral part of action while Lind (1984) further stated that attitudes constitute the interaction of a person with socio-psychological environment. The socio-psychological environment aspect of

attitude implies that various attitudes are underpinned by their environment of location. It is in this direction that Lind (1984) opined that attitudes are acquired and not part of the innate personality traits of an individual. This means that the attitude of construction operatives towards material wastage is mainly shaped by their environment.

Chaiklin (2011) opined that a psychological definition of attitude consider verbal expression as a behaviour while the sociological definition of attitude borders on the verbal expression of the intention to act. Chaiklin (2011) considers attitude as the mental position with regard to a fact or state or feeling or emotion towards a fact. This definition of attitude perfectively fit into the cognitive aspect of attitude which was earlier identified by Allport (1935); Converse (1970); and Lind(1984).

2.2 Attitude of workers on material usage on Construction site

Studies have investigated the role of construction worker attitude in waste generation. Earlier studies were conducted by Lingard *et al*. (2000) and Teo and Loosemore (2001). Others include Dainty and Brooke (2004); Saunders and Wynn (2004). These studies revealed that construction workers and other participants in project delivery recognize the impact of their actions on waste generation but are reluctant to implement waste minimization measures in the construction industry.

Attitude of construction workers towards material wastage have been categorized into conscious and unconscious by Fapohunda *et al.*(2011). The various aspect of conscious attitudinal tendencies of construction workers in waste generation include inadequate planning; lack of experience and skilled workers; over-procurement of labour; unplanned redundancies and waiting time of plant and equipment; non standardisation of design dimensions with manufacturers' standards; safety factors in relation to time ; and repetitive work due to poor workmanship. The unconscious attitudinal factors consist of human error and carelessness; lack of adequate planning to foresee

redundancy of resources; complexity of design and inadequate specifications; lack of site experience from previous job; and double handling due to resources positioning, trafficking and movement.

Recently, Rao *et al*. (2014) explored waste minimization in construction industry and came out with findings which are related to attitude of workers on construction site as far as material wastage is concerned . Table 2.1 below provides some of the key causes of material wastage which are linked to the attitude of construction workers.

Table 2.1: Attitude related causes of material waste

s/no	Attitude related causes of material wastage on construction site
1	Determination of types and dimensions of material without considering waste
2	Lack of attention paid to dimensions of products available in the market
3	Mistakes, and changes in specifications
4	Slow decision making processes
5	Provision of insufficient information to project participants
6	Poor communication among the parties involved in a project
7	Rework due to workers mistakes/poor workmanship
8	Improper interaction between engineers and workers
9	Using wrong equipment/tool for execution
10	Using damaged equipment/tools which leads to rework
11	Unnecessary cutting of bars instead of using short pieces
12	Unnecessary chipping of plaster due to lack of interaction between finishing , electrical, plumbing teams
13	Using excessive thickness of plaster

14	Using excessive quantities during mixing more than the required
15	Cutting unnecessarily instead of using small pieces

Source: Rao *et al*. (2014)

According to Fapohunda and Stephenson (2011), carelessness is one of the attitudes of material wastage in construction site operation. The perception of construction material wastage as unavoidable by operatives on site is also a contributory factor to material wastage. The belief systems of construction operatives that the wastage of construction material is inevitable and allowance made by procurement for wastage are all attitudes which contribute to material waste on site (*See for instance* Fapohunda & Stephenson , 2011). Other attitudes related to material wastage on construction site include ignorance of operatives; nonchalance on the part of operatives; and displeased attitude of operatives towards material management (Sawacha *et al*., 1999).

In order to change the attitudes of construction workers towards material wastage, Merchant (1997) has suggested the use of reward system and punishment. Other forms of attitudinal reformation of construction workers towards the positive handling of construction material to minimize wastage include using a bar-code system for measuring the quantities of material delivered and returned, wastage generation can then be investigated Chen *et al*. (2002). Hendriks (1994) also advocated for the issuance of certificates by environmental authorities to organizations which pass the tight quality control scheme for recycled aggregates. In spite of the existence of motivational and reward schemes to change the attitude of players in the construction industry towards material waste, evidence suggest that construction organizations have not fully embraced the use of these schemes in their operations as a result of reasons such as lack of regulatory control and enforcement; lack of motivation; and lack of experience (Tam & Tam, 2006).

2.3 Factors responsible for material wastage on construction site

Agyekum *et al*. (2012) identified the factors responsible for construction waste as the stage of construction; type of construction work; and work practices on construction site. In another development, Garas *et al*. (2001) identified factors that contribute to construction waste as over-ordering, overproduction, wrong handling, wrong storage, manufacturing defects and theft or vandalism. Inadequate awareness of the impact of construction waste on the environment on the part of construction operatives and other parties to the construction project also contributes to the creation of waste **(**Papargyropoulou *et al*., 2011).

In addition to the earlier factors identified for construction waste generation, Al-Hajj and Hamani (2011) noted lack of awareness; excessive off-cuts resulting from poor design; and rework and variations. It has been identified from the above review that both Papargyropoulou *et al*. (2011) and Al-Hajj and Hamani (2011) agreed on lack of awareness as a factor for construction waste generation.

Furthermore, Al-Hajj and Hamani (2011) through the review of extant literature opined that sources of waste is characterized by four key factors such procurement, handling, operation and culture which they depicted in figure 1 below based on the earlier work of Lingard et al. (2000).

In a quantitative study by Ameh and Itodo (2013) , poor supervision, rework, poor material handling, design related errors, and inadequate workers‟ skill were identified as the most contributory factors to waste generation on construction sites. Other findings of the study include negligence and care free attitude of management; inappropriate specification; buildability problems; improper packaging; lack of management of the design process; theft and vandalism; lack of integration of waste

reduction- plan in the design and construction process and construction related error/omission.

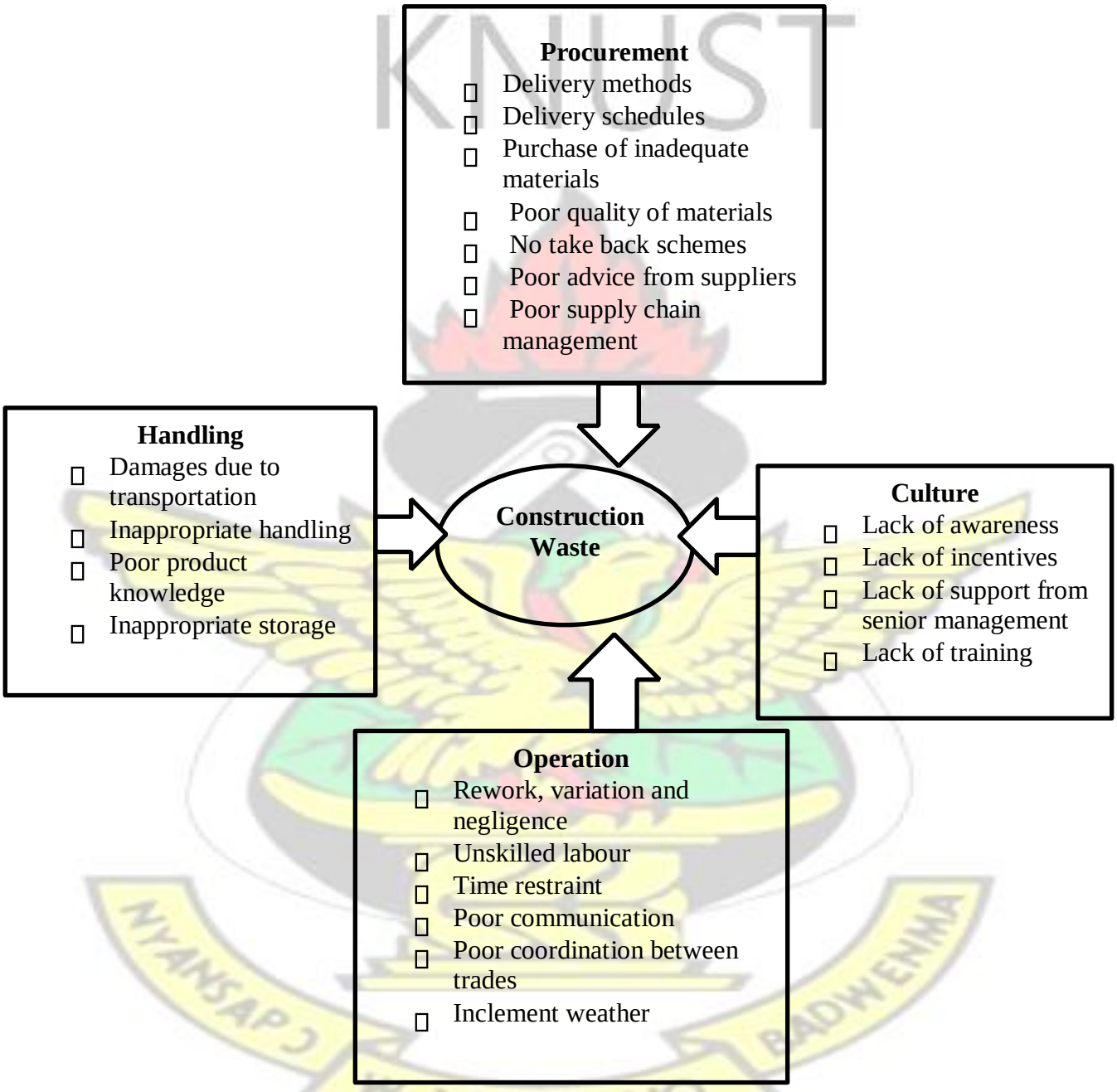

Figure 2.1: Origins of construction waste adapted from Lingard *et al*. (2000), Source: Al-Hajj and Hamani (2011)

2.4 Overview of Waste in the Construction Industry

Earlier studies have confirmed that the construction industry generates high level of waste from material usage. For instance, the construction industry consumes 3 billion tonnes of raw materials annually while one quarter of the world timber is used in the construction industry (UNEP, 2007; WGBC, 2010). It is of no doubt that majority of the waste generated emanate from construction industry related activities (Ameh and Itodo, 2013).

Construction waste is hazardous to the environment (Begum et al., 2006; Chen *et al*., 2002; Teo & Loosemore, 2001). The main types of construction waste include unavoidable waste (or natural waste); and avoidable waste (Formoso *et al*., 1999). However, Ekanayake and Ofori (2000) classified construction waste into categories of material, labour and machinery waste. According to Environmental Protection Department (2000) material waste comprises of unwanted materials from construction emanating from rejected structures, materials ordered in excess; and discarded materials (Agyekum *et al*., 2012).

According to Dania *et al*. (2007) construction waste is a complex waste stream, made up of a wide variety of materials which are in the form of building debris, rubble, earth, concrete, steel, timber, and mixed site clearance materials, arising from various construction activities including land excavation or formation, civil and building construction site, clearance, demolition activities, roadwork, and building renovation. Adding on, Napier(2012), opined that waste in construction occurs in various construction stages ranging from foundation works to finishing and they emanate from wooden materials, concrete, gravels, aggregate, masonry, metals, plastic, plumbing and electrical fixtures, glass and material handling.

According to Ameh and Itodo (2013) the commonest materials subject to waste generation on construction site during construction operation include mortar from plastering/rendering; and labour-only subcontracting options. Ekanayake and Ofori (2000) noted that material waste is "any material, apart from earth materials, which needs to be transported elsewhere from the construction site or used within the construction site itself for the purpose of land filling, incineration, recycling, re-using or composting, other than the intended specific purpose of the project due to materials damage, excess, non-use, or non-compliance with the specifications or being a byproduct of the construction process." To summarize , Ekanayake and Ofori (2000) in their definition perceive sources of waste in construction as (1) design; (2) procurement; (3) handling of materials; and (4) operation (Al-Hajj and Hamani, 2011).

The investment required for the mitigation of unavoidable waste is greater than the economic benefits achieved while the cost of avoidable waste is higher than the cost of its prevention (Agyekum *et al*., 2012). Similarly, the level of unavoidable waste is dependent on technology (Polat & Ballard, 2004; Formoso *et al*., 1999; Womack & Jones, 1996). Waste categories are dependent on their sources. In this direction Bossink and Brouwers (1996) identified sources of waste in the construction industry as emanating from construction design, procurement, material handling, operation and residue. According to Al-Hajj and Hamani (2011) construction waste are categorized by their state (solid, liquid or gaseous); by their characteristics (inert, combustible, bio-degradable, hazardous or nuclear); or by their origin (processing, household, emission treatment, construction and demolition or energy conversion),

Waste in construction has also been classified according to time and process (Al-Hajj and Hamani, 2011). Time and process waste is generated from activities that take time, resources or space without adding value **(**Al-Hajj and Hamani, 2011**)**. Adding on, Formoso *et al*. (1999) also observed that time and process wastes are losses produced by activities that generate direct or indirect costs but do not add value to the product from the point of view of the client. However, Al-Hajj and Hamani (2011) noted that waste generated through time and process can be minimized by lean construction.

According to Papargyropoulou *et al*. (2011) construction waste generation from unsustainable building materials are also linked to the hostile environmental impacts of the construction industry. Similarly, Fishbein (1998) has asserted that 10 to 30 per cent of wastes disposed of emanates from construction activities. As a result, Begum (2009) noted that construction waste is one of the single largest waste stream because of the low priority given to waste management by contractors. The construction industry generates significant amount of solid waste which mostly remain unmanageable hence creating environmental conditions (*see for instance* UNESCAP, 2009). Majority of these solid wastes emanating from the construction industry are mostly generated in urban areas (Mohd *et al*., 1998).

Wilson *et al*. (1998) identified the most solid materials which generate waste on site through handling as timber, metal, masonry and plasterboard and paper products. In addition, waste minimization through reuse and recycling are virtually nonexistent in the construction sector and natural resources required as building materials are available at relatively low cost (Begun *et al*., 2009). Waste minimization efforts must start very early during the construction process (Al-Hajj and Hamani, 2011). Furthermore, there is lack of mandatory requirement for construction firms to observe the practice of sustainable resource and waste management practices (Begun *et al*., 2009). To reduce

the mounting rate of waste management menace in the construction industry, construction industry regulatory bodies are required to develop the legal and regulatory framework through the formulation of "Construction Industry Master Plan" (Construction Industry Development Board, 2007). Similarly, site waste management plans to aid contractors or project managers to forecast and keep record of amount of construction waste to be generated to help reduce the level of waste generation in the construction industry (WRAP, 2007). The aim of construction site waste management plan is to improve materials resource efficiency by implementing reuse, recovery and recycling; and to minimise issues of illegal dumping by properly documenting waste removal processes (Defra, 2009). The construction site waste management plan which commences during the pre-planning stage and throughout the duration of the project requires the cooperation of all parties involved in construction project delivery , notably the client, contractor, designer, engineer, subcontractors, workers and even the suppliers to ensure efficient and effective construction waste management. The construction site waste management plan is mandatory in some developed countries including England, Singapore; United States inter alia (LEED, 2004; BRE, 2009). It is also required to develop key performance indicators and training of staff in the crucial aspects of construction site waste management in the management of construction waste (Papargyropoulou *et al*,. 2011). Monitoring, evaluation and reporting are also required during the duration of the entire construction site waste management. As a result, Papargyropoulou *et al. (*2011) have developed an outline for construction site waste management, which is indicated in demonstrated in Table 2.2 below.

Table 2.2: Construction Site Waste Management Actions

Project Stage	**Construction site waste management actions**
1. Project Set Up	1. Enter project details
2. Concept Design	2. Record waste prevention actions

3. Detail Design	1. Forecast waste 2. Record waste reduction actions
4. Pre-Construction	1. Specify waste carriers 2. Plan waste destinations 3. Record waste management and recovery actions
5. Construction	1. Enter actual waste arising, reduction, recovery and management activities. 2. Carry out training, monitoring and recording
6. Post Construction	1. Compare actual against forecast waste management activities 2. Assess performance based on KPIs 3. Suggest improvement for next project

Source: Adapted from Papargyropoulou *et al. (*2011)

Waste minimization is achieved through the efficient management of construction sites, use of innovative designs and new technologies (Grimes, 2005). Some have also proposed a construction waste management plan which include designating persons to be responsible for waste management; examination of designs for efficient material usage; evaluating material ordering and storage procedures on site; estimating waste generation on site; investigating waste disposal options; scrutinizing waste separation, transportation and storage system; developing worker incentive systems; and adoption of strategy for each stage of construction process. Similarly, Wilson et al.(1998) suggested training of workers in successful waste management operation and process optimization as the strategies for curbing the construction waste menace.

Various works have identified waste minimization measures in the construction industry (see for instance Al-Hajj and Hamani, 2011). Some of these measures include logistics management (WRAP, 2007a); supply chain management (DEFRA, 2008; Wrap, 2007a; CIOB, 2004; McDonald, 1997); modern construction methods (Broke, 2004); and training and motivation (Lingard *et al*., 2001). Drivers of waste minimization in construction are necessary for successful waste mitigation plan

implementation. Osmani *et al.* (2006) in their work have categorized the drivers of waste minimization as Government policies and contractual terms (Macozoma, 2002); environmental standards and assessment tools (Greenwood, 2004; Poon *et al.*, 2004; Powell *et al.*, 2001); financial benefits (Osmani *et al.*, 2006; Begum *et al.*, 2006; Tam *et al.*, 2005; Shen *et al.*, 2005).

Waste management Actions

Yu *et al.* (2013) have outlined some waste management actions in respect of certain construction materials to minimize construction waste. These actions are detailed in table 2.3 below.

Table 2.3: Material Waste Management Actions

Material	**Waste Management Actions**
1.Formwork materials	1. Metal formwork reused in other projects and scrap metal sold in the recycled market. 2. Disposal of timber waste to landfill sites
2. Concreting work	1. Batch plant erected in the construction site to serve projects. 2. Ready mixed concrete delivered to locations by mixer trucks. 3. Use ready mixed concrete from outsourced concrete supplier. 4. Concrete residues from the last truck load and slump tests used for paving temporary site access. 5. Surplus sorted in concrete clumps and disposed of at public fills for reclamation works
3. Tiles	1. Constantly collect surplus materials at working levels and redistribute it to other working levels. 2. Surplus materials are collected when tiling work was completed and removed to company‟s storage/yard for sale or future reuse. 3. Cutting waste dumped at ground level in the sorting area for sorting as inert material

Waste Minimization

Waste reduction is the most important core element of lean construction (Green, 1999). A central aspect of waste reduction is keeping the construction site well organized, clean and tidy (Salem *et al*., 2006). Workers should therefore be encouraged to clean the job site once an activity has been completed (Salem *et al*., 2006). A related aspect, crucial for waste reduction in lean construction, is efficient transportation and stockholding of material, often termed just-in-time (JIT) delivery, (Mao and Zhang, 2008). From a JIT perspective, inventories are not valuable and should be regarded as waste (Salem *et al*., 2006). Through JIT, contractors strive to receive smaller batches of material to the site when they need it in order to reduce stockholding and double-handling of material (Mao and Zhang, 2008).

In the perspectives of waste management, lean performances are important to generate flexibility in order to control organization waste; the focus is to reduce waste; not costs, (APICS, 2004). Anything that delays or impedes supply chain's flow must be analyzed as a potential non-value added activity. Some of the lean performances initiatives can be taken such as engaging and energizing people and supply chain partners to work together and individually to eliminate wasteful processes and excess inventory across the chain. This elimination of waste should have a significant byproduct, a reduction in cost for the supply chain.

2.5 Operatives attitude towards waste in the construction industry

Attitude is a positive or negative feeling toward specific objects; it exerts an influence on behavior **(**Begum *et al*., 2009). Whether consciously or not, behavioral decisions are frequently based upon attitudes (Fabrigar, 2004). Herremans and Allwright (2000) demonstrated that attitude, which includes awareness leads to action and performance

(behavior) regarding environmental management issues. Kulatunga *et al*. (2006) noted that for the successful implementation of waste management measures, a collective effort from all involved parties is important. Teo and Loosemore (2001) found that attitudes toward waste reduction are one of the reasons for difficulties in waste management in the construction industry. Loosemore *et al*. (2002) and Skoyles and Skoyles (1987) both highlighted the importance of human factors in the minimization of waste and both argued that waste can be prevented by changing attitudes.

The attitude of labour force has a massive influence on the organisation and performance of construction firms (Lill, 2008). Attitude of labour force affects the image of construction workers, this phenomenon is so severe that Liska (2002) asserted that the image of the construction industry is so low that labour force has developed negative attitude towards it to the extent that they will never recommend it to their children.

Studies have investigated the role of human behaviour in waste generation. The earliest studies were conducted by Lingard *et al*. (2000); Teo and Loosemore (2001); Dainty and Brooke (2004); Saunders and Wynn (2004). These studies revealed that construction industry participants recognise the impacts of their actions on waste generation with its concomitant effects on the environment but reluctant to implement waste minimisation initiatives. According to Fapohunda *et al*. (2012) construction site operatives perceive resources wastefulness as inevitable.

Construction is a labour-intensive industry and consequently, the effectiveness of waste management practices is dependent on the willingness of individuals involved in the construction process to change their attitudes and behaviour (Teo *et al*., 2000). Similarly, Skoyles *et al*. (1974) acknowledged that waste levels are more dependent on

human factors than upon the type of construction or building company employed to do the work (Faniran & Caban, 1998). More recently, other research has suggested that waste management practices were directly related to existing attitudes and the behavioural tendencies of individuals involved in the construction process (Skoyles *et al.*, 1987; Lingard *et al.*, 2000). Indeed, studies by Soibelman *et al.* (1994), Heino (1994) and Pinto and Agopyan (1994) have substantiated Skoyles *et al.*)1987) earlier findings and concluded that a change in people's attitude was much more important than changes in building technology. Collectively, these studies have highlighted the need for operatives to develop an awareness of the high value of materials and the adoption of more cautious work practices (Teo *et al*., 2000). It would appear that an understanding of operatives' attitudes to waste management could make a significant contribution to reducing levels of construction waste. Operatives are defined in this research as site foremen, leading hands, tradesmen, labourers and other workers in a technical, hands-on capacity. While there has been some attitudinal research at managerial level, there has been a complete lack of research conducted at operative level. This is an important deficiency because operatives make up the bulk of site work-forces and have the most direct contact with the materials being wasted (Rowings *et al*., 1996).

According to Olgyaiová *et al*. (n.d), changes in the attitudes of employees are most urgently needed to prevent the massive generation of waste in the construction industry. Other attitudinal related issues of waste generation in construction as identified by Olgyaiová *et al*. (n.d)include people (insufficient environmental awareness and concern which is the most often mentioned barrier of all; lack of understanding, will and effort; general reluctance to solve these matters; carelessness, insubordination and negative

attitude of the workers (leads to lack of economy; and people‟s attitudes as they tend to waste instead of save).

According to Intergraph Corporation (2012), the attitude of based on willingness, confidence, discipline, and cheerfulness to perform work or tasks can be lowered due to a variety of issues, including increased conflicts, disputes, excessive hazards, overtime, over-inspection, multiple contract changes, disruption of work rhythm, poor site conditions, absenteeism, unkempt workspace, among others will have the potential to contribute to the amount of waste generated on construction site.

Human-related situations such as worker motivation, worker boredom and fatigue, worker attitude and morale, worker‟s physical limitations, worker absenteeism, worker learning curve, worker experience, and worker skills as well as the team spirit of crew (Jergeas, 2009) affect the attitude of workers which subsequently affect the manner in which they handle materials and other resources on site to determine the level of waste.

Construction waste has been identified as the cause of escalating construction cost and slow progress of construction projects in Ghana (Kpamma & Adjei-Kumi, 2011). In a study conducted by Kpamma and Adjei-Kumi (2011) on the management of waste in the building design process in Ghana, several attitudinal issues were identified in relation to waste. Among the findings of this research are lack of familiarity with the concept of lean thinking; minimal integration of design and supply activities by Ghanaian firms; minimal involvement of contractors across the stages of pre-contract activities by consultants; and unnecessary or non-value-adding steps during construction processes. Other findings include low level of recognition accorded to sources of waste across all the stages of construction in the project delivery process; unnecessary processing; negative iteration or non-value-generating; and design errors and unnecessary processing.

A study by Begum *et al*. (2009) on the attitude and behavioral factors in waste management in the construction industry, revealed the following:

- large contractors have more positive attitudes regarding waste management practices as compared to medium and small contractors;
- contractor attitudes toward waste management are more positive if a contractor‟s employees have a higher level of construction-related education.
- contractors that follow source reduction measures or practices tend to have more positive attitudes toward waste management.
- contractors that follow reuse and recycling practices have more positive attitudes toward waste management as compared to those that do not. Source reduction, reuse and recycling are important measures of waste minimization (Tamand Tam, 2006; Lorton et al., 1988; Sherman, 1996; Maclaren, 2002) that are necessary in any waste management plan.
- contractor attitudes toward waste management are more positive if contractors have more experience in construction works.
- contractors that dispose of their waste into landfills have more positive attitudes toward waste management as compared to contractors that dispose of their waste in open places or utilize illegal dumping

In their work, Fapohunda *et al*. (2012) construction practices which provide underpinning for attitude formation towards wastefulness of resources. These practices include budgeting for waste thereby making allowance for wastefulness of materials, machinery, manpower, cost and time, during pre-contract and construction stages of the project; and the concept of pre-notion that wastage is normal.

CHAPTER THREE

RESEARCH METHODOLOGY

3.1 Introduction

This section examines the research methodology adopted for this study. The Section addresses data collection instruments, methods, and procedures. It provides detailed explanations to the methods engaged in the conduct of the study in order to address the research questions satisfactorily. Key among the issues in this chapter include research design and process; data collection and instrumentation which focuses on sampling and sample size determination; questionnaire design and its administration.

3.2 Research Design and Process

This study in its conduct adopted the quantitative approach. In doing this a survey strategy was used in gathering data from respondents using questionnaire. The design of the questionnaire was preceded by a desk study which explored the existing environment as far as waste on construction site is concerned. The use of survey became necessary as a result of the number of construction workers existing at the various construction sites. In using survey for data collection, the various sites were identified using the register of the various consulting entities supervising projects in the municipality.

3.3 Data Collection and Instrumentation

3.3.1 Data collection

Data collection was mainly by desk study and field survey. The desk survey (literature review) was very important for the data collection process as key variables were gleaned from the review of extant literature to design the field survey questionnaire. This approach to the questionnaire design was advocated by Fadhley (1991). The field survey was to collect empirical data for analysis upon which findings will be made regarding the attitude of construction workers towards material wastage on site.

3.3.2 Sampling and Sample Size Determination

Sampling refers to the selection of units of analysis for a study (Hunter *et al.*, 2002). The choice of a sampling technique is dependent on the research problem, purpose, design and practical implications of the research topic. Geographically, the Tamale Metropolis of the Northern Region of Ghana was the location of the study population consisting of construction workers of diverse training. The construction firms operating in the Tamale Metropolis were selected because of the complex nature of projects with diverse complexities being executed. The purposive sampling was used to select respondents from a population of top management comprising of project directors; project architects; technical directors; site managers; quantity surveyors; structural engineers; and geodetic engineers. Middle level management staff involved in the study includes store keeper; and time keeper /accountant / purchasing. The trades section of employees who are normally engaged in construction operations or activities on site include general foremen; trades foremen; masons; carpenters; steel benders; electricians; plumbers; mechanical operators; and drivers.

Purposive sampling is using deliberate effort to select respondents for a study by focusing on typical areas where these respondents can be located (Kerlinger, 1986; Rea and Parker, 1997; Struwig *et al*., 2001). Similarly, Krathwohl (1998), observed that purposive sampling is where respondents are assembled to intentionally seek the understanding of a phenomenon under investigation by choosing information-rich situations for study. The purposive sampling technique was used because the survey intends to seek the opinions, perspectives and experiences of respondents regarding material wastage on construction site. Similarly, the purposive technique was suitable for this study because of the nature of construction projects which makes respondents to be concentrated in a particular location.

In order to arrive at the survey population for the study, project management documents from construction consulting firms practicing in the Northern region were perused. At the end of the perusal of project documents, information regarding the composition of the survey population was gathered from thirteen projects that were being managed at the time of the conduct of this study. The survey population consists of nine (9) management employees; and nine (9) store keepers time keeper /accountant / purchasing. The composition of the operating staff at site consist of nine (9) general foremen; nine (9) trades foremen; fifteen (15) masons; nine (9) carpenters; twelve (12) steel benders; three (3) electricians; six (6) plumbers; twelve (12) mechanical operators; and eighteen (18) labourers. Hence the survey population was 111. It was revealed during the perusal of project documents for composition of the survey population that four of the construction firms contracted do not provide information regarding their management teams and general foremen.

3.3.3 Questionnaire Design

The questions were crafted by ensuring that they are relevant to the experiences of respondents as far as the conduct of the research on construction waste is concerned. The design of the questionnaire took into consideration factors namely appeal to respondents; readability; and supply of requisite data for the study. The questions were largely pre-coded and closed-ended with some opportunities for respondents to express their opinion as well.

Questions one to four explored the background of respondents by dwelling on the professional status and trades section; work experience and level of education. Questions five and six examine the existing issues on construction waste by looking at the severity of construction waste generation on projects; attitude of respondents towards construction waste; and aspects of construction project delivery that are mostly affected by construction waste. Also included in the design of the questionnaire was attitude related causes of material wastage on construction site which comprises of issues regarding construction workers attitude to construction material wastage. Other key aspects of the questionnaire design were materials most wasted as a result of human attitude; and guidelines for improving attitude of construction workers towards material wastage. The five point Likert scale was used to derive opinion of consultants on the issues enumerated above. The responses to the questions were 1= Not significant 2= Less significant 3= Moderately significant 4= Significant 5= Very significant.

3.4 Instrument Administration

The researcher personally administered the questionnaires to respondents in the Tamale Metropolis. The various project sites were visited and brief interaction with key leaders on the sites took place. After the brief interaction, the site leader introduced the

necessary personnel required for the study upon which the survey questions were distributed to them.

3.5 Data Preparation and Statistical tool for Analysis

The raw data was gathered and processed into form suitable for analysis (data sorting). They were then entered into datasets using the Software Programme for Social Sciences spreadsheet for the analysis to begin. Descriptive statistical tools were mainly used to analyse the data which was ordinal data in nature. Categorically, the main descriptive tools used included the mean score, standard deviation and indexes. Similarly, chi square which is a non-parametric tool was also used to determine the significance of the results. The selection of the analytical tool was contingent on a thorough review of available analytical and statistical tools.

CHAPTER FOUR

ANALYSIS AND DISCUSSION

4.1 Introduction

This chapter gives a comprehensive and analytical discussion of the result of the study in the form of tables and graphs. The initial aspect of the result deals with background information of the respondents.

4.2 Response Rate

The administration of the questionnaires commenced on the first week of August to the second week of September. Some of the questionnaires were retrieved on the spot while others were turned in by the respondents which lasted for two weeks. In all 111 questionnaires were administered and 105 were retrieved representing a response rate of 95%.

4.3 Respondents Profile

4.3.1 Trade Category of Respondents

Table 4.1 and 4.2 demonstrate the results of the study regarding the trade category and professional status of respondents. It was observed that profession of respondents in the construction industry was mainly quantity surveyor representing 22 percent of the valid response and architect representing 17 percent. Others professions represent 45 percent which comprise; site supervisor/foreman, administrators, plumber, carpenters, engineers, store keeper, project managers, etc. Majority of the respondents traded in the construction industry as masons representing 41 percent. Others comprise administration and management representing 15 percent of the respondents.

Table 4.1: Profession in the construction industry

Professionals	Frequency	Percent	Valid Percent	Cumulative Percent

	Architect	12	11.4	17.4	17.4
	Quantity surveyor	15	14.3	21.7	39.1
	Structural engineer	6	5.7	8.7	47.8
	Electrical/mechanical engineer	2	1.9	2.9	50.7
	Services Engineer	3	2.9	4.3	55.1
	Others	31	29.5	44.9	100.0
	Total	69	65.7	100.0	
Total		105	100.0		
			100		
Total		105			

Source: Field Study, 2014

Table 4.2: Trade in the construction industry

	Trades	Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Mason equipment	28	26.7	40.6	40.6
	Carpenter	7	6.7	10.1	50.7
	Plant and operator	4	3.8	5.8	56.5
	Electrician	3	2.9	4.3	60.9
	Plumber	5	4.8	7.2	68.1
	Labourer	7	6.7	10.1	78.3
	Steel bender	5	4.8	7.2	85.5
	Others	10	9.5	14.5	100
	Total	69	65.7	100	
Total		105	100		

Source: Field Study, 2014

4.3.2 Respondents' Work Experience

Figure 4.1 shows the number of years respondents have been in the construction industry. It was observed that 27 percent of the respondents have been in the construction industry for less than five year. Working experience among respondents

under the study was observed to have been presented in the figure. The respondents who have work between 5-10 years represent 25 percent, 11-15 years represent 26 percent, 16-20 years represent 18 percent and the extreme years thus over 20 years represent 5 percent.

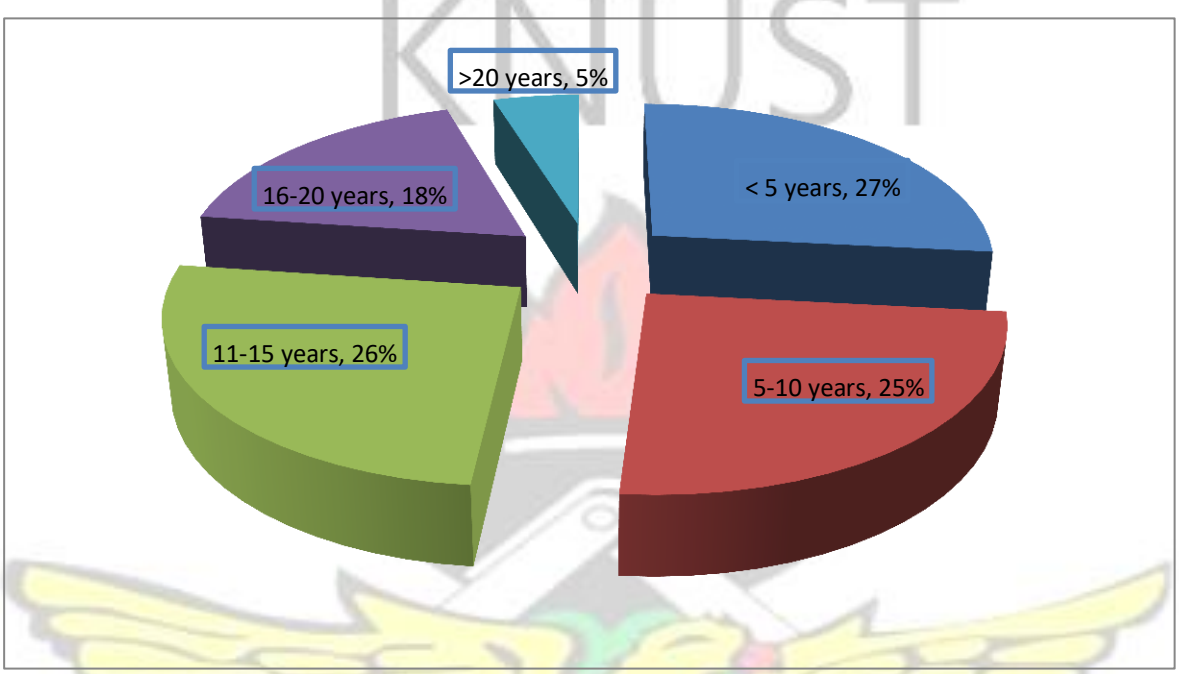

Figure 4.1: Number of years worked in the construction industry Source: Field Study, 2014

4.3.3 Respondents' Level of Education

It was observed from Figure 4.2 that respondents highest level of education comprises masters representing 9 percent, degree representing 24 percent, HND represent 26 percent. NVTI, SSCE and BECE respectively represent 28 percent, 5 percent and 10 percent. Respondents in the higher level of education were high. The other level of education respondents mentioned was construction technician, certificate and O"level. This implies that the respondents are literate hence the involvement in this study using the selected methodologies is appropriate.

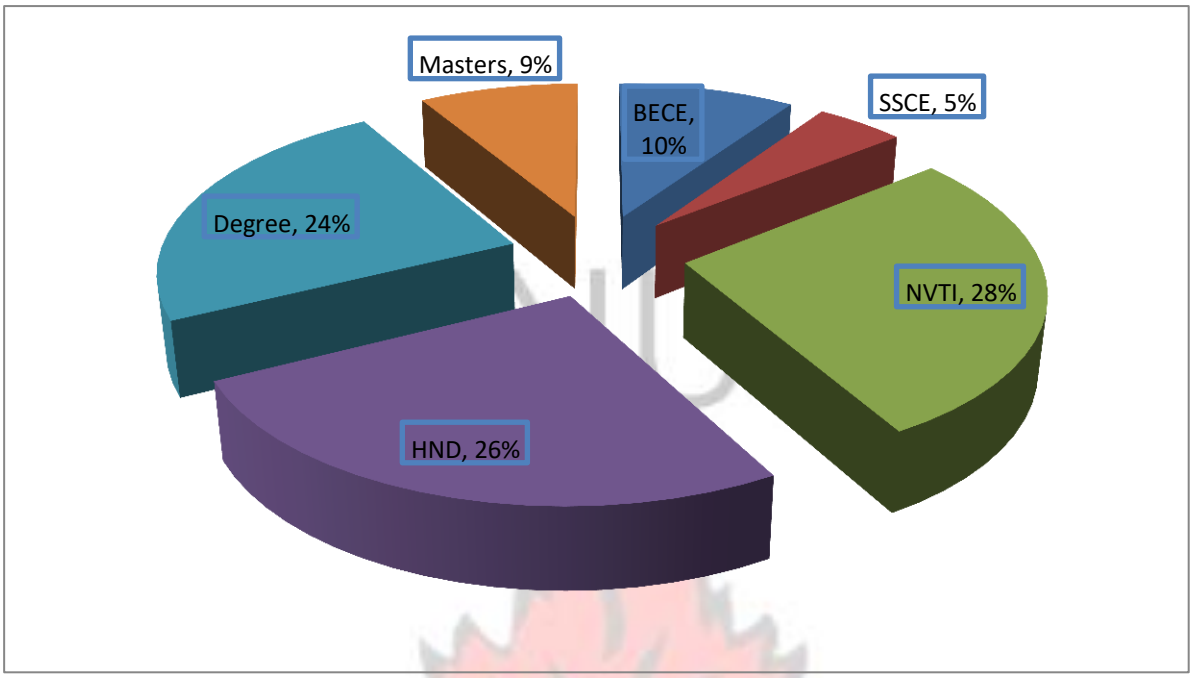

Figure 4.2: Highest level of education
Source: Field Study, 2014

4.4 Effects of construction waste on value of projects

Respondents were asked to indicate the severity of material wastage on the value for construction projects, responses were presented in Figure 4.3. Majority of the respondents indicated it was severe, representing 44 percent and very severe representing 22 percent. It was also indicated by 30 percent of the respondents as moderately severe and very few percentages indicated that material wastage on the value for construction projects was not severe. It can be said in general from the results that material wastage on the value for construction project was severe.

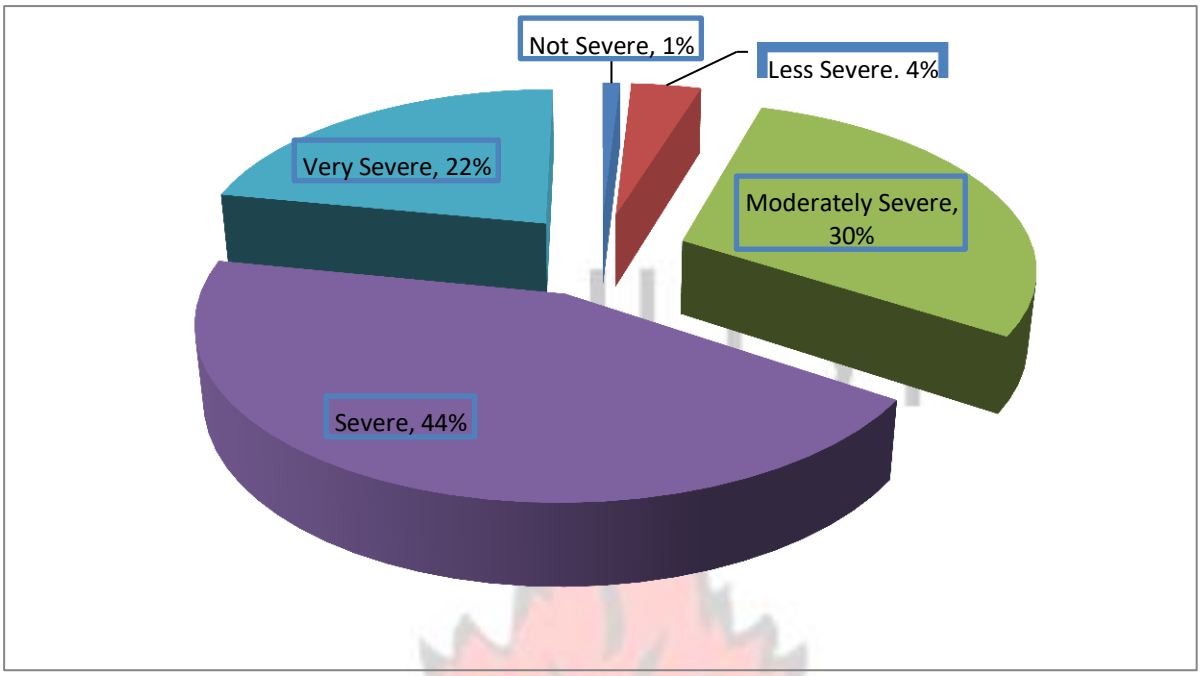

Figure 4.3: Severity of material wastage on the value for construction projects Source: Field Study, 2014

4.5 Typical Attitude of workers on material wastage on site

Respondents responded to the question measuring their usual attitude to material wastage on construction site. It was observed that 61 percent of the respondents were of the view that material wastage on construction can be avoided, 30 percent indicated that wasted material will be replaced, 8 percent think it was normal and 2 percent said it was unavoidable occurrence. This result therefore implies that majority of material wastage on construction site is avoidable. This means that strategies for changing the attitude of construction workers during material application ought to be intensified.

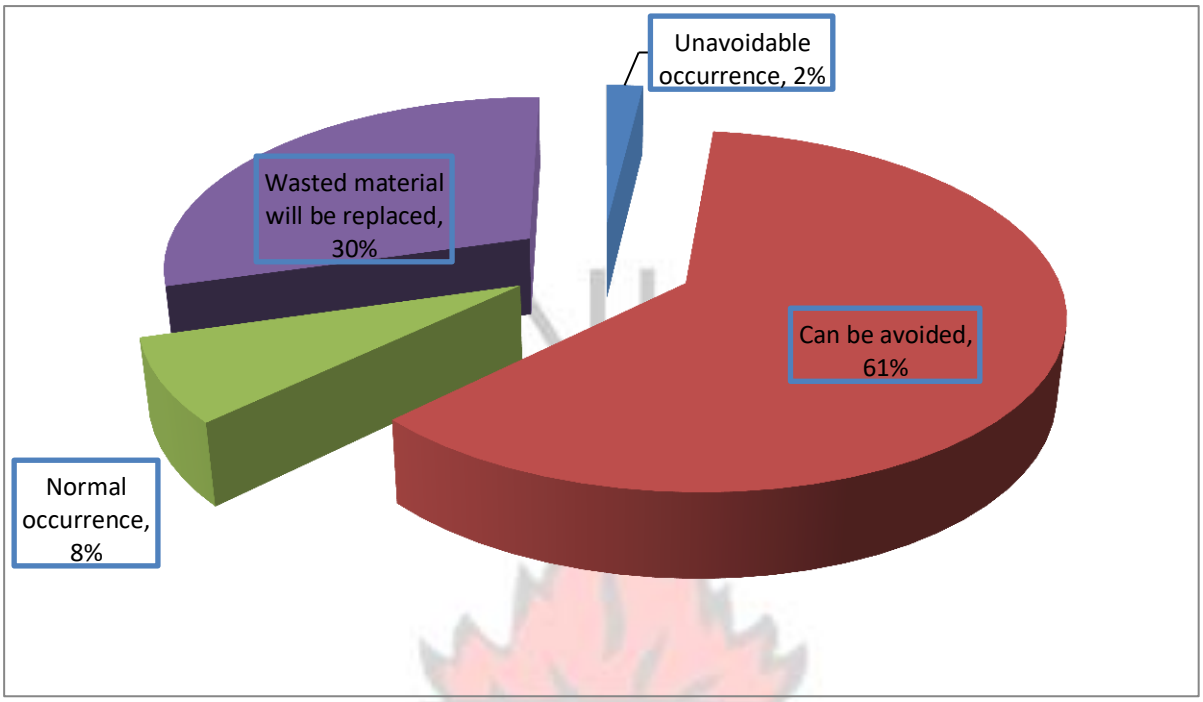

Figure 4.4: Usual attitude to material wastage on construction site Source: Field Study, 2014

4.6 Aspects of construction projects mostly affected by material wastage It was indicated by 62 percent of the respondents that cost of project was the most affected by material wastage during construction. The second most affected by material wastage during construction was quality of work representing 15 percent of the respondents, then delay completion of project representing 12 percent of the respondents and other related activities of the project representing 10 percent.

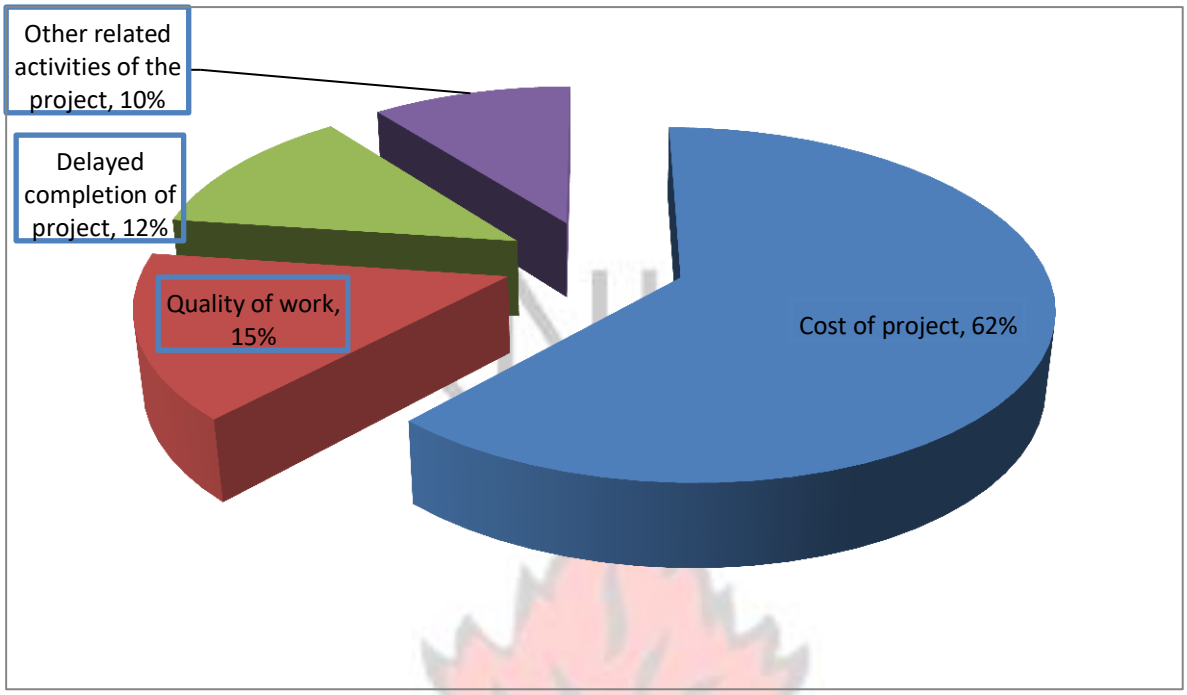

Figure 4.5: Most affected by material wastage during construction Source: Field Study, 2014

4.7 Human attitude related to causes of material wastage on construction site The human attitude related causes were averagely scaled highest among others was rework due to workers mistakes/poor workmanship. It was scaled with the mean value of 3.9 approximately 4 showing that this human-related causes to material wastage on construction site was significant. Human related cause to material wastage on construction site like; poor communication among the parties involved in a project with mean value 3.8, human error and carelessness with mean 3.78 and improper interaction between engineers and workers with mean value of 3.72 were also scaled as significant. All the variables had high mean value ranged between 3.2-3.6 and demonstrated *p*-values below 0.05 which demonstrate the significance of the results in Table 4.3. This implies that the attitude of construction workers is significantly related to the cause of material waste in construction.

Table 4.4 showed relative importance index of the variables measuring human-related cause to material wastage on construction site. All the variables were scaled highly

significant showing index greater or equal to 70 percent, except the last five variables that had index less than 70 percent. As it was observed in Table 4.3, the most significant human-related cause to material wastage on construction site was rework due to workers mistakes/Poor workmanship which was ranked first with index of 78 percent. The first three variables were scaled with index greater than 75 percent. Poor communication among the parties involved in a project and human error and carelessness with index 77 percent and 76 percent respectively. This revealed that poor communication attitude among workers in the handling of construction materials can result in the material being wasted.

Table 4.3: Attitude Related Causes of Material Wastage on Construction Site

Attitude Related Cusses	N	Mean	Std. Deviation	Chi-Square	df	Asymp. Sig.
1. Determination of types and dimensions of material without considering waste	104	3.41	1.22	26.096[a]	4	0.000
2. Lack of attention to dimensions of products available in market	105	3.56	1.082	58.190[b]	4	0.000
3. Mistakes, and changes in specifications	105	3.58	1.116	26.000[b]	4	0.000
4. Slow decision making processes	104	3.39	1.273	18.885[a]	4	0.001
5. Provision of Insufficient information to project participants	104	3.65	1.012	65.327[a]	4	0.000
6. Poor communication among the parties involved in a project	104	3.83	1.065	41.865[a]	4	0.000
7. Rework due to workers mistakes/Poor workmanship	104	3.9	1.111	43.404[a]	4	0.000
8. Improper Interaction between engineers and workers	105	3.72	1.096	32.095[b]	4	0.000
9. Using wrong Equipment/Tool for execution	104	3.23	1.381	29.173[a]	4	0.000
10. Using damaged Equipment/Tools which leads to rework	104	3.5	1.254	26.577[a]	4	0.000
11. Unnecessary cutting of bars instead of using short pieces	105	3.6	1.149	26.000[b]	4	0.000
12. Unnecessary chipping of plaster due to lack of interaction between finishing , electrical, plumbing teams	105	3.62	1.163	37.333[b]	4	0.000
13. Using excessive thickness of plaster	104	3.43	1.213	20.327[a]	4	0.000
14. Using excessive quantities during mixing more than the required	105	3.59	1.174	27.143[b]	4	0.000
15. Cutting unnecessarily instead of using small pieces	104	3.54	1.206	37.154[a]	4	0.000
16. Human error and carelessness	104	3.78	1.088	34.750[a]	4	0.000
17. Belief of operatives that material wastage is inevitable	104	3.48	1.277	21.481[a]	4	0.000
18. The pre-notion that allowance is made for wastage	104	3.13	1.285	14.365[a]	4	0.006
19. Ignorance of operatives	104	3.59	1.228	27.827[a]	4	0.000
20. Nonchalance on the part of operatives	104	3.49	1.014	45.135[a]	4	0.000
21. Displeased attitude of operatives towards material management	103	3.49	1.101	40.738[c]	4	0.000

a. 0 cells (.0%) have expected frequencies less than 5. The minimum expected cell frequency is 20.4.

b. 0 cells (.0%) have expected frequencies less than 5. The minimum expected cell frequency is 20.6.

c. 0 cells (.0%) have expected frequencies less than 5. The minimum expected cell frequency is 20.2. Source: Field Study, 2014

Table 4.4: Attitude Related causes of material wastage on construction site

Attitudinal Factors encouraging material wastage	N	Sum	RII	Ranking
1. Rework due to workers mistakes/Poor workmanship	104	406	78	1
2. Poor communication among the parties involved in a project	104	398	77	2
3. Human error and carelessness	104	393	76	3
4. Improper interaction between engineers and workers	105	391	74	4
5. Provision of Insufficient information to project participants	104	380	73	5
6. Unnecessary chipping of plaster due to lack of interaction between finishing , electrical, plumbing teams	105	380	72	6
7. Unnecessary cutting of bars instead of using short pieces	105	378	72	7
8. Using excessive quantities during mixing more than the required	105	377	72	8
9. Ignorance of operatives	104	373	72	9
10. Mistakes, and changes in specifications	105	376	72	10
11. Lack of attention to dimensions of products available in market	105	374	71	11
12. Cutting unnecessarily instead of using small pieces	104	368	71	12
13. Using damaged Equipment/Tools which leads to rework	104	364	70	13
14. Nonchalance on the part of operatives	104	363	70	14
15. Displeased attitude of operatives towards material management	103	359	70	15
16. Belief of operatives that material wastage is inevitable	104	362	70	16
17. Using excessive thickness of plaster	104	357	69	17
18. Determination of types and dimensions of material without considering waste	104	355	68	18
19. Slow decision making processes	104	353	68	19
20. Using wrong Equipment/Tool for execution	104	336	65	20
21. The pre-notion that allowance is made for wastage	104	326	63	21

Source: Field Study, 2014

4.8 Materials Mostly Wasted on Construction Site

Respondents were further asked to scale the materials which were mostly wasted as a result of human attitude. Table 4.5 shows the descriptive statistics of how these

materials were scaled. The variables with high mean values observed were; mortar, cements, plaster & grouting with mean value of 3.98, timber construction products with mean value of 3.84 and bricks & blocks with index of 3.69. These variables were scaled as significant. The rest of the variables with mean values approximately 3 showed that respondents scaled them as moderately significant. The standard deviations were low showing that the mean values were representative. The significant values show that there were significant differences among the scaling of the categories by the respondent.

The first three rankings of the materials most wasted as a result of human attitude were scaled as the most significant with index 80 percent, 77 percent and 74 percent respectively for mortar, cements, plaster & grouting, timber construction products and bricks & blocks. The next ranking materials were ceramics, plasterboard, sand, glass with index ranging from 65 percent to 69 percent showing that these materials were significantly scaled by respondents. This implies that mortar, cement, plaster and grouting; timber construction products and bricks and blocks are the most wasted materials during construction. Other materials in the category of most wasted per the above result of this study include ceramics, plasterboard, sand and glass. It is therefore important to install mitigation measures on construction sites to minimize the loss of these materials through waste.

Table 4.5:Materials most wasted as a result of human attitude

Attitudinal encouraging material wastage Factors	N	Missing	Mean	Std. Deviation	Chi-Square	df	Asymp. Sig.
1. Timber construction products	102	3	3.84	1.15	57.020[a]	4	0.000
2. Bricks & blocks	103	2	3.69	1.048	43.748[b]	4	0.000
3. Plasterboard	103	2	3.31	1.076	29.573[b]	4	0.000
4. Mortar, cements, plaster & grouting	103	2	3.98	1.102	59.087[b]	4	0.000

5. Insulation	102	3	3.1	1.104	22.902[a]	4	0.000
6. Metal	102	3	3.13	1.166	17.510[a]	4	0.002
7. Plastic products	102	3	3.02	1.134	25.255[a]	4	0.000
8. Ceramics	102	3	3.45	1.183	31.922[a]	4	0.000
9. Dry concrete products(paving, kerbing)	103	2	3.00	1.076	31.223[b]	4	0.000
10.Chippings	103	2	3.13	1.319	8.505[b]	4	0.075
11. Sand	103	2	3.27	1.246	14.524[b]	4	0.006
12. Plumbing and electrical fixtures	103	2	2.95	1.224	13.650[b]	4	0.008
13. Glass	101	4	3.25	1.244	12.614[c]	4	0.013

a. 0 cells (.0%) have expected frequencies less than 5. The minimum expected cell frequency is 20.4. b. 0 cells (.0%) have expected frequencies less than 5. The minimum expected cell frequency is 20.6. c. 0 cells (.0%) have expected frequencies less than 5. The minimum expected cell frequency is 20.2.

Source: Field Study, 2014

Table 4.6: Materials Most Wasted as a Result of Human Attitude

Materials most wasted through attitude	N	Missing	Sum	RII	Ranking
1. Mortar, cements, plaster & grouting	103	2	410	80	1
2. Timber construction products	102	3	392	77	2
3. Bricks & blocks	103	2	380	74	3
4. Ceramics	102	3	352	69	4
5. Plasterboard	103	2	341	66	5
6. Sand	103	2	337	65	6
7. Glass	101	4	328	65	7
8. Metal	102	3	319	63	8
9. Chippings	103	2	322	63	9
10. Insulation	102	3	316	62	10
11. Plastic products	102	3	308	60	11
12. Dry concrete products(paving, kerbing etc)	103	2	309	60	12
13. Plumbing and electrical fixtures	103	2	304	59	13

Source: Field Study, 2014

4.9 Ways of reforming/improving attitude of construction workers towards material wastage

Respondents were asked to indicate the effectiveness of the guidelines for improving the attitude of construction workers to reduce material wastage. Table 4.7 and table 4.8 showed how respondents rated each variable. The mean values of the guidelines were

approximately 3 indicating that these guidelines for improving attitude of construction workers toward material wastage were moderately significant. The variable with the highest mean value was bar-code system for material management for delivery and return (3.16) and use of reward system and punishment (3.06), conducting waste audit (3.03). There was significant difference among the scaling of the categories for all the ways proposed by respondents for reforming/improving attitude of construction workers towards material wastage as demonstrated in Table

4.7 below.

Table 4.7:Ways of Reforming attitude of construction workers towards material wastage

Proposed ways of reforming construction workers attitude to material waste	N	Missing	Mean	Std. Deviation	Chi-Square	df	Asymp. Sig.
1. Use of reward system and punishment	102	3	3.06	1.385	18.882[a]	4	0.001
2. Bar-code system for material management for delivery and return	102	3	3.16	1.272	15.157[a]	4	0.004
3. Conducting waste audit	102	3	3.03	1.375	10.059[a]	4	0.039
4. Issuance of certificates to construction firms for waste minimization	102	3	2.99	1.368	10.059[a]	4	0.039

a. 0 cells (.0%) have expected frequencies less than 5. The minimum expected cell frequency is 20.4.

Source: Field Study, 2014

Table 4.8: Ways of Reforming attitude of construction workers towards material wastage

Proposed Guidelines	N	Missing	Sum	RII	Ranking
1. Bar-code system for material management for delivery and return	102	3	322	63	1
2. Use of reward system and punishment	102	3	312	61	2
3. Conducting waste audit	102	3	309	61	3

4. Issuance of certificates to construction firms for waste minimization	102	3	305	60	4

Source: Field Study, 2014

4.10 Discussion of Results

Drawing on from the above presentation of results, it is clear that the main attituderelated causes of construction material wastage on construction site comprise of Rework due to workers mistakes or poor workmanship; and poor communication among the parties involved in a project. Others include human error and carelessness; improper interaction between engineers and workers; and provision of insufficient information to project participants. Earlier studies of Lingard *et al*. (2000); Fapohunda et al. (2011); and Rao et al.(2014) as far attitude related causes of construction material waste generation are concerned is in consonance with the result of this study.

It is important to explore the materials that are subject to frequent wastage by attitudinal related causes of construction workers. This study identified the materials mostly wasted as a result of the attitude of construction workers as mortar, cements, plaster and grouting; timber construction products; bricks and blocks; and ceramics. This findings are in agreement with the earlier findings of Ameh and Itodo (2013) and Wilson et al. (1998) regarding frequently wasted construction materials.

It is necessary to reform the negative attitudes of construction workers. This is necessary to reduce the level of material wastage during construction activities. In this light, the main ways of reforming the attitude of construction workers as identified by this study include Bar-code system for material management for delivery and return; Use of reward system and punishment; and Conducting waste audit. The earlier works of Nai-Hsin (2009); and Tam and Tam (2006) are clearly in consonance with the findings of

this study as far as the ways of reforming the attitude of construction workers in relation to material wastage is concerned.

CHAPTER FIVE

SUMMARY OF FINDINGS, CONCLUSIONS AND RECOMMENDATIONS

5.1 Introduction

This is the last chapter of the study and it consists of review of study objectives and findings; recommendations of the study; future research agenda; and conclusion of the study.

5.2 Review of Study Objectives and Findings

This section of the study is intended to review the research objectives which were crafted from the research questions designed to guide the conduct of this study. The review of the research objectives is intended to answer the research questions posed to guide the study. In this light the objectives of this study were:

Objective 1: Identify the attitudes of construction workers towards material wastage

Attitudes are crucial in the usage of materials. It cannot be under estimated when it comes to the usage of construction materials on site. Equally important to this study is the attitude of construction workers in relation to material wastage during construction. In tandem with the research question and this particular objective of the study, the study found that construction material wastage is unavoidable as far as their attitude is concerned.

Objective 2: Determine factors that encourage construction workers attitudes towards material wastage

This aspect of the study sought to uncover the underlying factors that encourage material wastage on construction site. The identification of these factors will aid in the development of strategies to curb them to minimize material wastage in construction.

Hence the study identified key factors in this regard as rework due to workers mistakes/poor workmanship; poor communication among the parties involved in a project; human error and carelessness; improper interaction between engineers and workers; provision of insufficient information to project participants.

Objective 3: Uncover the key aspects of construction projects mostly affected by material wastage

The study found that project cost is significantly affected by material wastage. This is followed by quality of work and then delayed in completion of work. It is also appropriate to identify the main aspects of construction projects that are affected by attitude related material wastage.

Objective 4: Identify the most wasted construction material through the attitude of construction workers

In the light of this, the study identified the most wasted materials through the attitude of construction workers as mortar, cements, plaster and grouting; timber construction products; bricks and blocks; and ceramics. Critically observing the mean scores and rankings of materials in Table 4.5 and 4.6, it can be concluded that all the material are mostly wasted through the attitude of construction workers. The identification of materials which are wasted most through the attitude of construction workers will help in the management of those materials. By identifying these materials special tracking mechanisms can be put in place to reduce the level of wastage.

Objective 5: Propose ways for promoting positive attitudinal change among construction workers on material wastage

It is also important to uncover key ways regarding that would be used in promoting the development of positive attitude among construction workers in order to curb the rising

rate of material wastage among them. The study therefore identified the use of bar-code system for material management for delivery and return; use of reward system and punishment; conducting waste audit; and issuance of certificates to construction firms for waste minimization.

5.3 Conclusion of the Study

The conduct of this study has revealed that material waste is avoidable especially those emanating from the attitude of construction workers. Though construction materials wasted are avoidable, the phenomenon is persisting which has affected the cost component of construction projects negatively. Poor communication and collaboration are also related to materials wasted on construction sites. As a result, pragmatic actions in the form of on the job training geared at changing the attitude of construction workers will be a novelty. This training can be in the form of briefings provided before the placement or handling of materials.

5.4 Recommendations of the Study

It is recommended that construction workers are trained in the various avoidable strategies of material handling. Similarly, specific efforts to develop the positive attitude of construction workers towards material waste generation must be undertaken to ensure judicious use of materials on during construction. It is also recommended that managements of construction firms institute the use of bar code to check theft and amount of materials delivered to site. The use of bar code will also ensure the tracking of materials in transit as this would provide real time information on the status of materials.

5.5 Future Research Agenda

The conduct of this study just like any other study of this kind has limitations as a result of constraints beyond the researcher. In this light, the following researcher agenda are proposed:

- A strategic study into the application of bar codes in the management of construction materials;
- This study was limited as far as the knowledge of construction workers especially operatives in relation to the application of construction materials is concerned. An investigation into the level of knowledge acquisition of construction operatives regarding materials handling during placement will be appropriate;
- Additionally, a study delving into the beliefs and practices of construction operatives in the handling of construction materials within the entire construction supply chain system is necessary; and
- Assess the role of collaboration and effective communication among construction workers and other stakeholders in construction processes to reduce material waste

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APPENDIX 1: QUESTIONNAIRE

This research is a Postgraduate level research entitled "*Attitude of Construction Workers towards Building Material Wastage"* and intends to thoroughly explore to investigate the attitude of construction workers toward construction material wastage and management in order to promote sustainable construction. **Kindly respond to the questions by ticking (√) the appropriate response.** 1. (a) What is your profession in the construction industry?

[ ] Architect
[ ] Quantity surveyor
[ ] Structural engineer
[ ] Electrical/mechanical engineer [ ] Services Engineer
Other (Specify)……

(b) What is your trade in the construction industry?

[ ] Mason
[ ] Carpenter
[ ] Plant and equipment operator
[ ] Electrician
[ ] Plumber
[ ] Labourer
[ ] Steel bender
Other (Specify)……

2. How long have you been working in the construction industry?

[ ] < 5 years
[ ] 6 - 10 years
[ ] 11 - 15 years
[ ] 16 - 20 years
[ ] > 20 years

3. What is your highest level of education?

[ ] BECE
[ ] SSCE
[ ] NVTI [ ] HND
Other (Specify)……

4. What would you say about the severity of material wastage on the value for construction projects?

[ ] Not severe [ ] Less severe [ ] Moderately severe [ ] Severe [ ] Very severe

5. What is your usual attitude to material wastage on construction site?
   [ ] unavoidable occurrence [ ] Can be avoided [ ] [ ] Normal occurrence [ ] Wasted material will be replaced
6. Which of the following will be most affected by material wastage during construction operation?
   [ ] cost of project [ ] quality of work [ ] delayed completion of project [ ] Other related activities of the project

Attitude Related causes of material wastage on construction site

7. How significant are the following human attitudes related to material wastage on construction site? Use the scale: 1= Not significant 2= Less significant 3= Moderately significant 4= Significant 5= Very significant

s/no.	***Attitude related causes of material wastage on construction site***	***1***	***2***	***3***	***4***	***5***
1	Determination of types and dimensions of material without considering waste					
2	Lack of attention to dimensions of products available in market					
3	Mistakes, and changes in specifications					
4	Slow decision making processes					
5	Provision of Insufficient information to project participants					
6	Poor communication among the parties involved in a project					
7	Rework due to workers mistakes/Poor workmanship					
8	Improper Interaction between engineers and workers					
9	Using wrong Equipment/Tool for execution					
10	Using damaged Equipment/Tools which leads to rework					
11	Unnecessary cutting of bars instead of using short pieces					
12	Unnecessary chipping of plaster due to lack of interaction between finishing , electrical, plumbing teams					
13	Using excessive thickness of plaster					
14	Using excessive quantities during mixing more than the required					

15	Cutting unnecessarily instead of using small pieces					
16	Human error and carelessness					
17	Belief of operatives that material wastage is inevitable					
18	The pre-notion that allowance is made for wastage					
19	Ignorance of operatives					
20	Nonchalance on the part of operatives					
21	Displeased attitude of operatives towards material management					
s/no.	***Suggest some attitudinal related causes of material wastage on construction sites and rank accordingly***	***1***	***2***	***3***	***4***	***5***
22	……					
23	……					
24	……					
25	……					
26	……					
27	……					
28	……					
29	……					
30	……					

Materials most wasted as a result of human attitude

8. Which of these construction materials are the most wasted as a result of human attitude on

construction site? Use the scale: 1= Not significant 2= Less significant 3= Moderately significant 4= Significant 5= Very significant

s/no.	*Materials most wasted as a result of human attitude*	*1*	*2*	*3*	*4*	*5*
1	Timber construction products					
2	Bricks & blocks					
3	Plasterboard					
4	Mortar, cements, plaster & grouting					
5	Insulation					
6	Metal					
7	Plastic products					
8	Ceramics					
9	Dry concrete products(paving, kerbing etc)					
10	Chippings					
11	Sand					
12	Plumbing and electrical fixtures					
13	Glass					
s/no.	***Proposed in your opinion some materials mostly wasted as a result of human attitude and rank accordingly***	*1*	*2*	*3*	*4*	*5*
14	……					
15	……					
16	……					
17	……					
18	……					
19	……					
20	……					

Guidelines for reforming/improving attitude of construction workers towards material wastage

9. What would you say about the effectiveness of the following guidelines for improving the attitude of construction workers to reduce material wastage? Use the scale: 1= Not significant 2= Less significant 3= Moderately significant 4= Significant 5= Very significant

s/no.	***Some guidelines for reforming/improving attitudes of construction workers material wastage on construction sites***	*1*	*2*	*3*	*4*	*5*
1	Use of reward system and punishment					

2	Bar-code system for material management for delivery and return					
3	Conducting waste audit					
4	Issuance of certificates to construction firms for waste minimization					

10. What do you think are some of the guidelines for promoting positive attitudinal change in construction waste management? Use the scale: 1= Not significant 2= Less significant 3= Moderately significant 4= Significant 5= Very significant

s/no.	***Some guidelines for reforming/improving attitudesof construction workers material wastage on construction sites***	***1***	***2***	***3***	***4***	***5***
1	……					
2	……					
3	……					
4	……					
5	……					
6	……					
7	……					
8	……					
9	……					
10	……					