ASSESSING CONSTRUCTION AND DEMOLISHING DEBRIS USAGE IN THE GHANAIAN CONSTRUCTION INDUSTRY

By

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DECLARATION

I hereby declare that the submission is my own work towards the Master of Science in Construction Management and that, to the best of my knowledge it contains no material previously published by another person, nor material which has been accepted for the award of any degree of the University, except where duly acknowledge has been in the text.

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ABSTRACT

Lots of construction and demolition waste are produced in the course of construction activities which has a serious impact on surroundings, if it's not properly handled. This has become a serious issue in the Ghanaian Construction industry. Other issues of waste management on construction sites has caused lots of failures like increasing the cost of project and the loss of materials that are valuable Based on that, the research aim at exploring the usage of construction and demolishing debris in the Ghanaian Construction Industry. Three major objectives were derived from this aim to help achieving it. The objective was, to identify the usage of construction debris in the Ghanaian Construction Industry, to determine challenges of usage of debris in the Ghanaian Construction Industry, to identify critical success factors for utilization of construction debris in the Ghanaian Construction Industry. Quantitative research approach was used for the study, alongside with a purposive and snowball sampling technique. Out of the 50 questionnaires administer, 31 were retrieved. The variables were analyzed using means score, descriptive statistics and a reliability of the scale checked using Cronbach Alpha coefficient. All variables identified were ranked in order of importance and usage. The revealed that, the Ghanaian construction industry make use of construction debris as filling material for landfill, land reclamation and many others. However, some challenges were identified as hindering factors to the proper utilization of these waste materials. Strategies through the study were identified as mitigating factors to help increase the rate of their usage.

Keywords: **Construction debris, Waste management, Ghanaian Construction Industry**

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I say may Jehovah Elyon richly bless you all!!!

DEDICATION

I dedicate this thesis to all construction professionals worldwide and anyone who loves construction.

CHAPTER ONE

GENERAL INTRODUCTION

1.1 BACKGROUND OF THE STUDY

The construction industry plays a vital role improving the quality of life and in meeting the needs of society (Aleksanin, 2019) and in that regard, globally, matters concerning environmental protection has become very significant. When put in a comparative position with other sectors a great amount of solid waste and environmental pollution agents are produced from this industry (Ayarkwa et. al., 2011). Compared with other industries, construction generates fairly large amount of pollutants, including solid waste, noise, dust and water. Waste was defined simply as "that which can be eliminated without reducing customer value' by Polat and Ballard (2004). Construction and demolition process are considered to be a major source of waste in terms of weight, volume, and quantities (Lu and Yuan, 2010; Tchobanoglous and Kreith, 2002). Zutshi and Creed, (2015) asserts to this suggesting that the very nature of traditional construction practices results in massive amounts of waste generation. Naturally in the environment, non-decaying waste keep aggregating leading to the need for frequent utilization of new plots of lands as burial pits (Aleksanin, 2019). With the construction industry producing close to 20million tons of waste each year, the dire situation of waste generation on site cannot be overstated. The issue of waste management is alongside plan of preserving the hydrosphere and atmosphere from pollution, issues of conservation of biological and land resources (Aleksanin, 2019). Baldwin et al., (2009) state that the creation of waste on construction projects is very dynamic; hence, being able to predict volume of waste or debris presents a complex task yet to be figured out.The construction has continually been sensitized to the reuse of waste and recycling practices, however (Ofori et al., 2000) It remains regrettable that even with the interests of stakeholders in reputing traditional

methods for sustainable ones, the vast majority of construction firms still disregard the idea of adopting progressive waste management strategies (Ayakwa et al. 2011).

Nevertheless, managing of construction and demolition waste effectively leads to reduction in cost of projects overall (UNEP; UNITAR, 2013) as well as saving the environment from harmful pollutants. These has led to the introduction of some strategies to minimize the production of waste on construction projects. If the generation of waste cannot be prohibited or can only be prohibited at a certain level, then the succeeding phase should be the usage and recycling of the waste of construction and demolition, which can help in effective management and productivity (Esin and Cosgun, 2007; Poon 2005). In Ghana, Ayarkwa and Adinyira (n.d.) reported a wide variation in wastage rates of projects and this between 5% and 27% the project supplies purchased. With this industry being a Major driver of economic growth, large wastage rates largely affect the national economy. This creates the need for exploration of alternative usage of waste produced from construction projects.

Waste management methods have included the reuse of debris formed from construction as alternative material for some specific purposes. It's largely influenced by the type and nature of waste produced as well. This study seeks to look into the usage of construction debris within the Ghanaian construction industry as a waste minimizing and control measure.

1.2 STATEMENT OF THE PROBLEM

The construction industry today, is actively redeveloping, repairing and reconstructing residential, public and industrial facilities (Aleksanin, 2019). With the constant increase in the number of buildings under construction and being demolished, construction waste continues to grow, and in most case possess the potential for second use is minimal (Ulubeyli, 2017). In many developing

countries as said by Nagapan et al. (2012), waste of construction and demolition is a problem considering its effects that it brings on the environment and the economy of the country and its social aspects. The European Union labeled the construction and demolition waste as a priority waste stream and this comes as no surprise, the main physical waste produced from construction activities tend to be largely material and often left overs of concrete and steel are commonly wasted Nagapan et al. (2012). An enormous amount of studies has been carried out with focus on construction waste and negative impacts they pose on the social, economic and surroundings are evident in the findings produced (Yuan, 2012). These impacts also translate to a reduction in productivity on construction projects and in effect spiraling a downward trend in performance of the overall project. The process of waste management requires not only an assessment of the quantitative characteristics but also the type and composition of the waste ought to be considered in order to efficiently carry out the process of reusage of the waste (Ulubeyli, 2017).

This study is focusing on how construction debris is used within the Ghanaian construction industry. Other studies have in the past focused on the general management of waste on construction sites as well as exploring waste minimization factors. However, the specifics of waste have generally not been explored. The challenges each type of waste brings influence its reusability the limited literature on the usage of construction debris in Ghana presents a gap sought to filled by this study.

1.3 AIM AND OBJECTIVES OF THE RESEARCH

This section discusses the research aim and objectives of this study.

1.3.1 Aim of the Research

The aim of this study is to explore construction and demolishing debris usage in the Ghanaian Construction Industry

1.3.2 Objectives of the Research

1. To identify the usage of construction debris in the Ghanaian Construction Industry
2. To determine the cause of debris generation in the Ghanaian Construction Industry
3. To examine critical success factors for utilization of construction debris in the Ghanaian Construction Industry

1.4 RESEARCH QUESTIONS

2. What are the novel ways of using construction debris in the Ghanaian Construction Industry?
3. What are the cause of debris generation in the Ghanaian Construction Industry?
4. What critical success factors could be implemented for proper utilization of construction debris in the Ghanaian Construction Industry?

1.5 SIGNIFICANCE OF THE RESEARCH

This study is significant because, it presented the current state of construction debris in the Ghanaian Construction Industry. The study helped the researcher to comprehend the fundamental problems of construction and demolishing debris in the construction sites. Certain matters like several strategies to manage waste on site were addressed as a plus in this study. This was to help other researchers who will concentrate on this area of study.

The study further brought into light some information about the construction industry, and how waste has been dealt with in past year to these present times. This was to help the reader understand the in-depth knowledge of how waste has been dealt with and certain techniques that have failed in the management of construction and demolition debris.

The trends of construction debris usage in the Ghanaian Construction Industry were also be presented in this study, which helped construction workers to be update and such things under this topic. The study is also significant because it added up to the body of knowledge by determining the critical success factors for proper utilization of construction debris in the Ghanaian Construction Industry.

1.6 SCOPE OF THE RESEARCH

Scope of researches are in two main forms: the contextual scope and the geographical scope. In context, this study was limited to assessing the usage of construction and demolition debris in the Ghanaian Construction Industry. Waste in the construction industry comes in several forms. Several researchers tend to classify unproductive hours even as waste; however, this study looked at only construction debris, more specifically concrete waste. Moreover, in the construction industry, the study was limited to only D1K1 construction firms in Accra Metropolis.

For geographical scope of this study as stated earlier, the study's scope was limited to only Accra Metropolis. Hence, construction firms in the Accra Metropolis were the only firms who were considered for this study. However, there was further restrictions like construction firm class that one belongs, active participation in institutional bodies and actively working which help in defining specifically the scope of the research for this study.

1.7 SUMMARY OF METHODOLOGY

In attaining the very purpose of this study, presentable and appropriate literature regarding the area of the study was reviewed. There was also a wide explanation of Literature review, which helped develop an excellent understanding of the study. Base on this literature, which comprised the main aim and objectives of the study. The questionnaires were tactically prepared, which helped to determine the trends and assessment of construction and demolishing debris usage in the Ghanaian Construction Industry.

The accepted methodology for this study is the quantitative method, this is because of its numerical and mathematical analysis. Therefore, data for study will be obtained from primary and secondary sources. Secondary data will be gathered from existing literature on assessing the usage of construction and demolition debris in the Ghanaian Construction Industry. Google Scholar, Emerald, KnustSpace as well as Scopus among others will be the scientific search engines which will be used for this study. The obtained data from the literature review was strategically compounded into close and open-ended questions and served to the target population in person and electronically. The population for the study was mainly limited to project professionals in D1K1 construction firms. Data will be collected from respondents with the help of their level of interest. This research selected its sample using the purposive and snowball sampling method. The primary data retrieved from the survey will be analyzed using descriptive statistics (means, frequencies, and standard deviations), mean score ranking. The reliability of the scale was checked by using the Cronbach's Alpha coefficient test. Software for analysis was Statistical Packages for Social Sciences (SPSS) windows version 21, Microsoft Excel 2019 and Microsoft Word 2019.

1.8 ORGANISATION OF THE THESIS

This thesis is arranged chronologically, following the rules and guidelines of presenting master's thesis in KNUST. Holistically, the thesis consisted of five main chapter (General Introduction, Literature Review, Research Methodology, Data Analysis and Discussion of Results, and Conclusions and Recommendations of the study). Notwithstanding, there were several subheadings under each main chapter based on how best it fits in explicating that particular chapter for easy acculturation of the concept being presented. Nevertheless, clarity was sought and care would be taken not to create several subheadings under the various headings to confuse the logic in the document. Chapter one covers the general introduction of the study, and as a general introduction, it started with a background to the study, then the problem statement (gap in literature which this particular study intends to fill), the research aim and objectives, the research questions, significance, methodology, scope and organization of the research. Chapter two tackled the literature review of the study. In chapter two the conceptual, empirical and theoretical reviews of assessing usages of construction demolition waste would be presented. The chapter following suit is the Chapter three – Research Methodology; this chapter presented on the several research methods which would be adopted for the study. Informing on the philosophy to use, the approach to adopt and the strategies to use for the study. The next chapter is the Chapter four (Data Analysis and Discussion of Results); this chapter considered the data which would be retrieved from the survey, the tools of analysis and the discussion of the results thereof. The last chapter for the thesis was the conclusions and recommendations (Chapter Five); this chapter draws the curtains of the study to a close by concluding and analyzing whether all the objectives of the study have been attained, making recommendations, stating the limitations and showing directions for future research in this area of study.

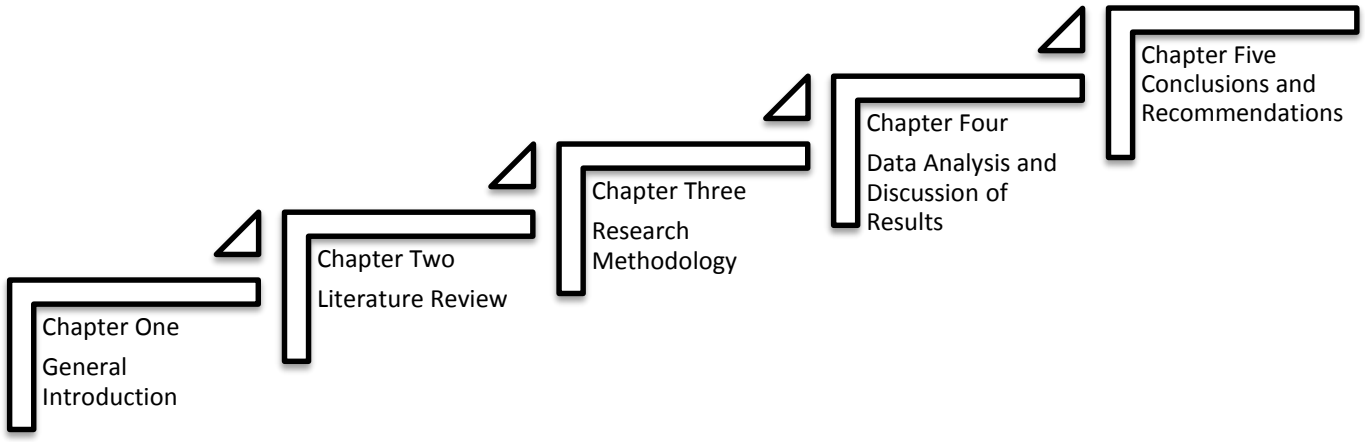

Figure 1.1: Conceptual Diagram of Thesis Organization

Source: Author's Construct (2019)

1.9 SUMMARY OF CHAPTER ONE

This chapter presents a summary of the study being conducted. Inferring from the organization of thesis, the form to which the entire thesis would take is shown. Critically considering this chapter, it can be inferred that background of the study which is a summary of the literatures on the study is well presented. Also, the reasons for the study is shown, as well as the scope and methods which would be adopted for this particular research. Moreover, the aim, objectives and research questions of the study is well-articulated in this chapter together with the statement of the problem.

CHAPTER TWO

LITERATURE REVIEW

2.1 INTRODUCTION

Construction and demolition waste: Waste emerging from any land removal or formation, civil or building works, roadwork, building redesign or demolishing exercises. It incorporates different kinds of structure waste, rubble, earth, concrete, timber and mixed site clearance materials (Saez, et al, p.7). Alarcón (1997) characterizes waste as every other material unique in relation to unquestionably the base amount of assets of materials, equipment, and labor important to increase the value of the item. In this way, waste is assets that don't enhance a product. This isn't a long way from the depiction that waste is resources that do not add value to a product. Rogoff and Williams, (1994) characterizes construction waste as unused and unviable materials left on site. In the perspective on Westerveld (2003), construction waste is an undesirable material from construction exercises. Individuals make this presumption most likely in light of the fact that taking a gander at waste from that point of view makes it moderately simple to see and measure.

Sadly, paying little heed to the simple measurement of waste from that definition, this perspective has been vigorously condemned. As per Gudigar, et al., (2014), at each phase of construction the information sources get twisted, disposed of, downcast, limited, disrespected, unhealthy, deformed, deteriorated and henceforth grouped and named as waste. As per Wahab and Lawal (2011), waste can be created at different phases of the construction procedure like the planning stage, costing or construction stage. Shen, et al, (2010), stipulated that, construction waste emerges from different sources, by and large from the initiation of development through to the consummation of a construction project. Research have demonstrated that a considerable measure of material waste is produced in any development project (Lu *et al*., 2011). Material waste makes

a ton of money related misfortune to the contractor which is more often than not transferred to the client now and then prompting suit.

2.0.1 Classification of Construction and Demolition Waste

Construction and demolition waste are typically grouped into two principle parts: 1) inert; 2) non-inert (Johnston and Mincks 1995).

Inert waste incorporates rocks, rubble, concrete, cement, asphalt, rubbles, blocks, tiles, stones, soil and sand. This sort of waste is appropriate for land recovery. A portion of this sort of waste can likewise be utilized in recycling.

Non-inert waste is around 20% of the total construction and demolishing waste (GovHK N.D). It incorporates wood, timber, paper, metal, bamboo, trees, glass, plastics, garbage, life form and installations. This sort of waste isn't appropriate for land recovery (EPD 2009a), since it will disintegrate gradually underground by bacterial activities and sink progressively. Such land recovery undertakings are usually targeting making new land for buildings or different structures. On the off chance that the buildings structures were based over the land with much non-inert materials, it would result in great structural issues.

As per Castelo Branco (2007:13), construction waste can be grouped into physical and financial waste. This grouping incorporates the following:

- Physical misuse of materials: Additional measure of materials with respect to those indicated in the task.
- Physical misuse of worker hours: Man-hours expanded by deferral in the entry of materials and overproduction.

- Physical waste of equipment: Equipment hours expanded in capacity of the issue cited for the labor.
- Financial waste because of physical waste: Determine the expenses related with physical waste.

2.1 THE NOVEL WAYS OF USING CONSTRUCTION DEBRIS IN THE CONSTRUCTION INDUSTRY

2.1.1 Recycling

Recycling incorporates gathering recyclable materials that would some way or another be viewed as waste, grouping and handling recyclables into raw materials, for example, fibers, fabricating raw materials into new items, and obtaining recycled items (USEPA 2009). In a lot of instances, recycling costs remain lower than the costs of disposing of materials, and this is very rare and occurs typically amongst small job contracts. However, for routine construction projects, it is cogent to recycle material arising from the delivery as it makes economic sense (Osmani, 2008). A critical point worth noting is that, supposing the disposal costs are lower than recycling costs, it economically accurate not to recycle. But if recycling is cost competitive or less expensive than disposal, then recycling should be considered as part of every job (ibid).

2.1.2 Reuse

Reuse includes putting a thing to another utilization after its unique purpose has been satisfied. The items are utilized various occasions before they are disposed of (GRC 2004). The systems of waste administration incorporate the following (Kibert and Chini 2000): Avoid, Reuse, Recycle, Compost, Burn, Dispose at landfills.

2.1.3 Land Reclamation

Land recovery includes altering wetlands or conduits to change them into usable land, for the most part with the end goal of improvement (Smith 2009). Therefore, this examination would concentrate on the staying three different ways for minimization of construction and demolishing waste. They include 1) circumventing waste; 2) re-utilizing materials; and 3) recycling waste.

Avoiding waste alludes to any training that dodges or limits waste at source. Re-utilizing and recycling waste allude to the re-utilizing and reusing of waste materials, and in this manner, lessening the volume of waste which should have been disposed to the landfills (Ferguson et al. 1995). It is prescribed that minimization of waste at source ought to be given the most astounding need (Crittenden and Kolaczkowski 1995), in light of the fact that it is in every case increasingly productive to limit the production of waste at source than to create ways for treating or dealing with the waste.

Despite the fact that Recycling and reusing enable waste materials to be put into a useful use, recycling and reusing don't totally maintain a strategic distance from the waste production (Faniran and Caban 1998). Recycling and reusing can just diminish the amount of waste to be in the long run deposed to the landfill sites. Since reusing requires less vitality and procedures in managing the waste than recycling, reusing ought to be placed in higher order than recycling (Crittenden and Kolaczkowski 1995). The chain of command of the three methods for minimization of construction and demolishing waste ought to be: 1) avoiding waste; 2) reusing waste; 3) recycling waste; 4) disposing waste. Numerous examinations have discovered that modernization, work procedure and practice have a gigantic commitment in creating C&D waste. Be that as it may, human conduct additionally has a significant role in waste causation and minimization in construction industry (Teo and Loosemore 2001). Along these lines, aside from improving the present practices and

innovations, successful instruction of the workforce, exhaustive review methods and enactments could bring about progress in waste minimization execution (Dainty and Brooke 2004).

Construction and demolishing (C&D) debris is created from the development, remodel, or destruction of a structure. Disposal keeps on being the essential technique for the management for the waste stream. Examination of standards management of wastage, for example the '3Rs' guideline (reduce, reuse and recycling) assists waste management designs just as training and research of development and demolishing management. The standard is orchestrated with rising request dependent on their effect on nature. Limiting the waste produced is a compelling approach to the management of waste. This is on the grounds a limited amount of waste can limit CDW production and expenses related to transporting it for waste disposal and recycling. In addition to this is the reuse approach which presents itself as a more viable technique in overseeing CDW in comparison with recycling (Kareem et al., 2015; Lu and Yuan, 2011).

Notwithstanding the management techniques mentioned as well as its progressive ways, Ajayi et al. (2015) talked about various techniques. Arranging and recycling, material usage, utilization of expectation devices for waste, site plans for wastage, structure for adaptability and deconstruction, waste productive procurement, offsite development just as administrative and monetary policies, and each methodology highlighted as:

Sorting and recycling systems may be deployed after existence of waste.

"**Recycling** includes division of recyclable and nonrecyclable waste during development/project exercises or at the sites for " Such a system can possibly avert waste from landfill sites just as forestall the utilization of raw materials for material creation. Development/construction waste recycling activities have helped communities to have free space in their landfill site. Recycling

tasks are important to lessen CO2 emanation and spare vitality just as make openings for work. For effective recycling activities, the presence of committed construction experts to sort the waste materials are essential (Barros et al. 1998: Ajayi et al. 2015).

Material re-use: Similarly, supply is basic to divert squander away from disposal destinations. In differentiate to reusing, such administration strategy for wastage makes conceivable the reuse of materials with no alter to its physical and compound state. For occasion, development annihilating fabric has been utilized once more for arrive recuperation, concrete totals, and asphalt covering. "Reuse" rule is more craved than reuse. The target of the run the show is to broaden lifetime of existing structures or materials (Lu et al., 2016: 899).

Utilization of waste expectation devices: Is employed as a strategy in the effort to development excesses. Squander prediction gadgets are moreover vital for supervising improvement of waste efficiently. Typically, Net Waste is an apparatus utilized in the UK to gauge waste emerging from the construction procedure. Various frameworks utilized over the world to anticipate CDW. Waste expectation apparatuses ought to be executed in the structure periods of the construction procedure (Ajayi et al., 2015). They give an edge in trying to predict the amount of waste which is likely to be produced by b a certain time learning from regular usage.

2.2 CAUSES OF DEBRIS GENERATION IN THE GHANAIAN CONSTRUCTION INDUSTRY

Numerous contractual workers and other development staff participate in numerous exercises during development process that does not increase the value of the development venture (Ekanayake and Ofori, 2000). These non-esteem including exercises can be named as waste.

2.2.1 Poor site management

Poor site management and supervision is a noteworthy easygoing element of waste generation which influences the general advancement of construction. This was expounded in Wang et al. (2008) inquire about in China. The creators stipulated that, absence of management abilities and absence of supervision is a key reason of considerable measure of waste generation on building sites. Besides, in Chile, it was distinguished by Serpell et al. (2000) that poor or absence of supervision causes waste generation in the construction business mostly on location. A later report directed by Lu et al. (2011) expressed that waste additionally happens because of the poor construction management on all construction undertakings executed. Besides, a pilot study led in Sri Lanka stipulated that a lot of construction waste is for the most part because of ill-advised management and supervision of sites (Jayawardane, 1998). The discoveries expressed above demonstrates that, poor site supervision is a noteworthy donor of waste in the construction business which influences cost management.

2.2.2 Lack of experience

Absence of experience in favor of the two experts and temporary workers (contractors and consultants) is additionally a noteworthy reason for waste which influences cost in the construction business. This affirmation was buttressed by specialists in South China who concentrated crafted by steel drinking sprees. They referenced that fortification works taken care of by unpracticed steel drinking sprees is the primary driver of support waste (Lu et al., 2011). The considerable measure of waste they cause additionally have huge impact on the efficiency and advancement of work. Lee and Sivananthiran (1996) likewise conceded to the attestation and they expressed that a generous level of remote provisional work has practically no involvement in construction. Moreover, unpracticed foremen add to increasingly inadequate works in Hong Kong construction

industry (Wan et al., 2009). Rogoff et al. (1994) additionally accepted that a ton of waste produced is because of the inability field director.

2.2.3 Inadequate planning and scheduling

Because of the hazard nature of construction, arranging of exercises is key as it demonstrates the required contribution at different phases of a construction venture. Insufficient arranging and booking is another significant construction waste generator is deficient arranging and planning. Various scientists bore witness to a similar reality expressing that lack of common sense and planning is a key variable causing waste. For instance, an investigation directed by Ekanayake and Ofori in 2000 distinguished ill-advised arranging as the most basic operational supporters of waste generation. Material wastage can likewise happen because of ill-advised arranging. Moreover, flawed arranging of construction brings about material waste (Polat and Ballard 2004).

2.2.4 Variations during construction

Variation of construction works can likewise prompt construction waste generation as significant changes may bring about demolishing and remaking. As per Wan et. al. 2009 variation bring about a high volume of construction waste. Blunders and mix-ups in designs may prompt variation during construction and may incorporate a lost segment in the structure. Australian specialists recognized a comparative outcome from their examination and assembled common construction trash cause into configuration change and plan blunder (Faniran and Caban, 2007). Likewise, an examination led in China by Zhao and Chua (2003) recognized that revamps brought about by the variations is another type of critical waste generator. Revamp includes demolishing and re-construction which may include extra materials and work and transfer of harmed materials on landfills because of demolishing.

2.2.5 Mistakes during construction

Mix-ups during construction are likewise a noteworthy reason for wastes in construction. It happens because of default from construction strategy (Wang et al., 2008). Absence of capacity to manufacture a task can expand cost of a project from around 6-10% of aggregate of undertaking cost in United Stated (Koskela 1992) which is additionally a factor in construction waste. As per Pheng and Tan (1998), botches during construction can fundamentally cause enormous waste generation.

2.2.6 Unnecessary construction of laborers and goods

Pointless movement of individuals is a noteworthy wellspring of waste that influences cost and its management. This kind of waste is subject to work by representatives. Ohno (1988) classes construction of waste into waste and work. Waste is a movement that does not include worth. Once more, superfluous transport of products on site which may emerge because of inappropriate site design have critical impact on schedule and cost. Site unskilled labour ought to be coached and made to understand the cost of wastage. When sensitized properly the tendency or minimizing waste is possible(ibid).

2.2.7 Overproduction

Overproduction is likewise an alternate kind of waste which can be related with over-utilization of materials and abundance contribution of vitality by workers into creation. Ohno (1988) sort this kind of waste as indirect waste where materials are not physically lost but rather causing just a money related misfortune and expanding cost of generation. For instance, waste because of solid chunk thickness bigger than determined by the auxiliary plan. This over-plan fundamentally does not have any effect on the structure but rather can have huge effect on expense. Accurate order of

works should be made to prevent the excess production and purchasing of supplies for the delivery of the project (Osmani, 2008).

2.2.8 Other reasons for waste generation

There are different reasons for waste generation nearby and these may incorporate;

Wrong construction techniques:

Deformities

Poor streamlining in performing undertakings.

2.3 CRITICAL SUCCESS FACTORS FOR UTILIZATION OF CONSTRUCTION DEBRIS IN THE GHANAIAN CONSTRUCTION INDUSTRY

Various writings have distinguished various ways and procedures to diminish construction waste. As per Gudigar et al. (2014), creating of a construction waste the board plan, which can be commonly sorted into four noteworthy gatherings. These are contract language, design issues and construction methods; building materials detail; and instruction. Every one of these classifications falls under the design phase of a venture. As indicated by Osmani et al. (2008), waste minimization methodologies executed appropriate at the plan stage are increasingly productive and viable in light of the fact that bidders know even before the venture begins. In perspective on this, various analysts like;

Coventry and Guthrie (1998), Greenwood (2003), Poon et al. (2004), and Baldwin et al. (2006), have shown that the modeler has an imperative task to carry out in construction waste minimization and reduction since they are the most dynamic partners in the structure phase of an undertaking. In this way, Coventry and Guthrie (1998) recommended three key obligations the draftsmen ought

to play in guaranteeing waste minimization in the construction business and they included; offering guidance to customers, improving plan practices and so on.

2.3.1 Advising of Client

This is done by briefing the customer on the effect of waste generation and featuring advantages including cost investment funds. As indicated by Dainty and Brooke (2004) numerous customers don't have sufficient data about the seriousness of construction waste. Waste minimization could be an extremely critical activity by both the customer and experts when they know, distinguish and examine the benefits of waste reduction at different phases of a construction procedure. In perspective on this, Innes (2004) deduced in his investigation that reserve funds of about 3% can be made without critical venture cost.

2.3.2 Improvement of design practices

Waste can likewise be limited by improving design practices by tending to the key causes of design waste. As indicated by Coventry and Guthrie (1998), design waste could be dealt with by tending to the different issues experienced during the design procedure which will encourage better coordination at project stage. This will wipe out various causal operators of waste and spare construction cost with no speculation expense. Legitimate design will dispose of regular structure and itemizing changes to keep away from failed work during site activities, design for deconstruction, intending to limit wastage through off-cuts, the utilization of recovered materials; and proper determination of plan execution and products and improve plan.

2.3.3 Contract and legally binding agreement

At the agreement and legally binding agreement stage, various measures can be set up which could assume an exceptionally basic job in diminishing waste. This should be possible by preparing for

explicitly waste minimization situated contract delicate statements (CRiBE 1999). A regular model was distinguished by Dainty and Brooke (2004) who recommended the utilization of legally binding statements to punish poor waste execution contractual workers.

Greenwood writing in 2003 set forward comparative proposal and went further to recommend the joining of a completely coordinated waste minimization system at the contract stage. This technique that was set ahead by Greenwood recognize and impart the obligations regarding waste minimization between all the construction venture partners.

2.3.4 Standardization of design

Writings demonstrates that, an immense volume of waste which legitimately influences construction cost is produced because recently changes during building site tasks. These corrections may change the sort or amount of project materials required at a particular phase of an project (Coventry et al., 2001). The author expressed that institutionalization of plan as a construction strategy improves the simplicity of structure and lessens the amount of waste produced. Hylands (2004) had comparable discoveries in his examination and the writers contended that institutionalization of both structure designs and components bring about less waste generation. Baldwin et al. (2006) concurred with the way that institutionalization is a noteworthy method for diminishing waste generation, and he went further to express that pre-casting and prefabrication offer huge ways to lessen waste generation. Dainty and Brooke (2004) likewise stated that the utilization of off-site prefabrication prompts better control of waste and harm.

2.3.5 Management support

As per Teo and Loosemore (2001), management should indicate more noteworthy responsibility to waste management. This will urge representatives to view waste management as a significant

part of the construction procedure on site and hence they will endeavor to lessen waste generation during construction on site. Waste management has a low necessity during construction ventures and insufficient is done to reduction waste generation (Teo and Loosemore, 2001). Management inclusion can help raise the significance related with waste management. Likewise, they can give recycling offices to help diminish unavoidable waste produced.

2.3.6 Effective planning of construction process.

Legitimate planning of construction procedure is a significant technique in lessening construction waste generation nearby. Planning reductions waste generation at source.

Experienced professionals in the waste and environment contamination fields prescribe that reduction of waste at source ought to be given the most astounding need when creating systems for waste minimization (Crittenden and Kolaczkowski, 1995). This is on the grounds that, reasonably, it bodes well to maintain a strategic distance from waste generation that to create broad courses in treating waste.

2.3.7 Government activities

The government likewise have a task to carry out in the reduction of waste generation in the Ghanaian construction industry. The government of New South Wales, Australia proposed to accomplish a 60% reduction in waste in the year 2000 by making changes to their current Waste Disposal Act. Their current Waste Disposal Act concentrated on the capacity, gathering, treatment and transfer of waste (Faniran and Caban, 1998). Comparative system can be embraced in Ghana to diminish the measure of waste produced in our building sites definitely.

2.3.8 Incentives

At the point when waste management is done successfully, it realizes cost investment funds and it is the most alluring advantages to decreasing waste (Teo and Loosemore, 2001). In this manner, site staff and different businesses should profit by the potential cost investment funds of waste reduction as remunerations and impetuses to urge them to put more exertion in waste reduction. This will likewise make consciousness of the financial advantages of waste reduction.

2.3.9 Proper supervision

As indicated by Teo and Loosemore (2001), legitimate supervision of tasks at site will speed up laborers work and diminish the quantum of waste produced. Workers will in general waste more with no or low supervision. Additionally, appropriate supervision will lessen the instances of robbery and pointless material wastage as they likewise structure a segment of waste created on building sites. Linked with the preparation of accurate work orders, it is prudent that staff receive the right supervision to ensure plans and instructions are stuck to minimize the production of waste on the project Faniran and Caban, (1998).

2.3.10 Other factors

Site waste management planning (SWMP): Numerous nations, SWMP is an administrative necessity. A typical instance in the UK, saw each task, over £ 300,000, has SWMP as a prerequisite in its enactment structure (Ajayi et al., 2015). This is a plan that outlines the amount and type of waste which may be produced on a projects site and how it can be reuse, recycled are further disposed. An update of the plan is made during the construction process and the issues surround how it's to be used is recorded.

Design for adaptability and deconstruction: When an enhancement of a structure's design made to suite industry standards such that expelled components superbly add up in a different enhanced structure. A typical example of this are the World Cup Qatar which are completely reusable after the event. And this was made possible due to a design for adaptability preconceived and executed (FIFA, 2018)

Waste productive procurement: the obtainment arrange could be a noteworthy arrange for administration arranging in a development wander. The reason behind improvement squanders are unseemly fabric stockpiling, bundling fabric, and twofold dealing with are connected/related with the acquirement arrange. For this reason, various methodologies, for example, Just in time conveyance (JIT), less bundling material and improved joint effort between the supply chains must be connected to guarantee waste productive procurement. JIT is utilized to limit waste (Ding et al., 2016).

Offsite construction: This approach comprises construction supplies being fabricated remotely and collected onsite. Prefab and remote fabrication present methods that constrain waste production within the development commerce (Ding et al., 2016). The appropriation of construction may constrain development and decimating squanders that are gotten on account of destitute workmanship, large requests, plan alterations, hurt amid cutting and establishment (Tam et al., 2007). Construction can reduce development fetched through robotization, industrialization and standardization.

Legislative and tax measures: incorporated in policies are fines for pollutions, for example, "pay as You Throw" (PAYT) and varies charges of landfill. On account of PAYT, fines are required to be accounted for in a pro rata rate of volume, or weight of the disposed wastages on landfills.

Utilizing the standard of PAYT, employed in various European Union nations, (UK, Netherlands, Greece, Switzerland, Sweden) empowers the drive to limit the measure of waste arranged on disposal grounds. Preceding the reception of PAYT, charging plans fixed in the United States as landfill punishment. In any case, the plan fails to demonstrate growth in the waste reduction drive at landfills. Notwithstanding the previously mentioned expense measures, administrative measures additionally help to limit C and D wastes. Authoritative toolboxes assume an incredible job in expanding the consciousness of the development business related to the management of wastage (Ajayi et al., 2015).

A portion previously identified in other systems of waste management get talked about amongst different researchers. In a similar case, Saheed et al. (2016) likewise talked about plans at adaptability and deconstruction. Development waste escalation can likewise get limited using a deconstruction plan together with a structuring a structure adaptable as well as versatile. SWMP helps with overseeing waste nearby, and the arrangement conceivable by the management and recycling of waste nearby in an organized manner. Likewise, it is possible to lessen/decline waste cost/cost together with increment of the benefits of development division. SWMP may diminish chance that has occurred because of waste related mishaps. Furthermore, the requirement for onsite wastes intends to oversee/manage a development inventory network. Lu and Yuan (2012) and Wang et al. (2010) clarifies waste arrangement plans.

Categorizing for waste to be transfer or buried in landfills is seen as great methods (Lu and Yuan, 2012). Besides, an encouragement of sorting out waste should receive a reinforced action from site administrators and waste contractual workers remains pivotal (Lu et al, 2016). Kinds of cataloguing are: i.e., onsite and remote sorting. The benefit of onsite waste transportation incorporates expanding reuse and recycling rate, relieve expenses related to the movement of waste

and transfer, draw out existence of landfills. (Wang et al., 2010). What's more, as per Wang et al. (2010) "labor, reused materials advertise waste sortability, incredible administration, location space and equipment for orchestrating of improvement squander are essential accomplishment variables for on area orchestrating of advancement waste ". Remote arranging adds to a reduction of building waste (e.g.: remote development waste arranging program at Hong Kong in 2006). Economical procedure, backing and usage, engaging remote development, waste cataloguing, with extended transfer taken a toll result in achievement of the off-site advancement squander sorting program. This offers assistance and lessening of CDW (Lu and Yuan, 2012).

2.4 CHAPTER SUMMARY

This chapter extensively sought through past literature to find relevant information to inform and steer this study forward. Ensued in this chapter, a brief assessment of construction and demolition waste was done. Its effect on general environment and project itself as well causative factors were discussed. Further its highlighted novel was of using construction debris as alternative Material for certain construction works. Within this chapter as well keen challenges in the use of construction debris were detailed across previous studies. Closing this chapter, the critical success factor to ensure successful utilization of construction debris in the Ghanaian construction industry were also highlighted.

CHAPTER THREE

RESEARCH METHODOLOGY

3.1 INTRODUCTION

This research looks at exploring the barriers of renewable energy uptake in the Ghanaian energy sector. In chapter two a critical review of previous literature on the subject with aim getting an insight in it. This chapter will delve into the available choices in research methodology which can help give corrects answers to our objectives. It will start with an overview of research paradigms and the various philosophical considerations as fundamental beliefs that affect the ways of conducting a research. The chapter will then look into the research approach and the various elements included in it. Such elements, includes, research method and technique, study setting, units of analysis, sampling techniques, and many others. The different methods and techniques used in data collection are also outlined. These include questionnaire survey.

3.2 RESEARCH DESIGNS/ STRATEGY

Research design are mainly to help the researcher recover significant suggestion with less effort, time and money (Abernethy, 1988). Again, it is defined as a plan for a study which make available the overall framework for the collection of data (Adams and Schvaneveldt,1985). It is the measures used in collecting data for research. Research problems helps to determines the type of research design to be adopted, and for each research design, there are several research methods that can be applied in collecting and analyzing the generated data from the investigations (Walliman, 2011). These designs have been grouped into three types namely, Quantitative, Qualitative and mixed methods. However, the Qualitative and quantitative approaches ought not be viewed as polar opposites but instead, they show diverse ends across (Newman & Benz, 1998).

Quantitative approach uses scientific method with the initial study of theory and literature producing specific aim and objectives with proposition(s) and hypotheses to be tested and then verified or modified on the basis of the research findings (Phillimore and Goodson, 2004 cited by Paintsil, 2015). It is again explained by Weinreich, 2009. as methods from natural sciences that are designed to ensure objectivity, generalizability and reliability. This phenomenon is simply subject to mathematical logic. Quantitative is objective in nature. The objective of quantitative research is to develop and engage mathematical models, theories, hypotheses regarding the natural phenomena (Sarandakos, 2005). Accordingly, quantitative researchers have frequently sought to abstract the phenomenon which is being studied from the rest of the social world and to fix meaning within what might be described as a contextual vacuum (Phillimore and Goodson, 2004). Generally, quantitative approaches are used to address questions such as what, how much, how many? Quantitative approach will be used under this study. Data will be collected through self -administered questionnaires to research participant.

Qualitative approach is subjective in nature which aim at increasing the general understanding of situation. Research in situation such as this, is a function of researcher's insights and impressions (Kothari, 2004). They are social phenomenon that cannot be subject to mathematical logic. Knowledge in this approach are gain from the perspective of those involved. Qualitative data sources include observation and participant observation, case studies, interviews and questionnaires, documents and texts, and the researcher's impressions and reactions (Bryman, 2004). Hence, the adopted approach for the study was the quantitative research method.

3.3 SOURCES OF DATA

There are two types of data collection namely the primary source of data collection and the secondary source of data collection. According to Walliman, (2011), Data comprises of information that serves as raw material for researchers to come to an end in the event being studied. They are collected from

the original source by the researcher. They are mainly gathered to provide answers to research question or to meet the research objectives (Saunders et al., 2007).

Secondary data are already gathered and published data. They are in the form of journal, books of fact and figures from graduate personnel. However, this research is going to use both primary data and secondary data. The primary data for the study will be the issue of questionnaires to obtain data on construction debris from target respondents. Both sources were utilized in this study.

3.4 DESIGN OF QUESTIONNAIRE

The questionnaire was designed based on the findings of the literature review and in relation to the research objectives. The questionnaire focused on the general information of the respondents and sought the respondent's understanding construction debris usage, challenges hindering their utilization and finally strategies to help mitigate them.

The questionnaire was designed in two (2) main parts. The first part was divided into two (2) sections and under these sections, the first focus was questions that sought the respondent's experience on waste management such; their knowledge in waste management. The second part of the questionnaire was the feasibility test of construction debris usage in the Ghanaian Construction Industry. This part will also be divided into three (3) sections and under these sections shall firstly rank factors that are identified as practices of construction companies on the usage of construction debris. The respondents were asked to rank the questionnaire using the scale of 1 – 5 in order of likelihood: **'1'** represents **Strongly disagree**, **'2'** represents **Disagree**, **'3'** represents **Neutral**, **'4'** represents **Agree** and **'5'** represents **Strongly agree.** In the second section of the second part, the respondents were asked to rank the degree of the challenges of construction waste utilization using the scale of 1 – 5 in order of effectiveness: **'1'** represents **Not at all**, **'2'** represents **Slightly True**, **'3'** represents **Moderately True**, **'4'** represents **Mostly True** and **'5'** represents

Completely True. Finally, in the second part of the questionnaire, the respondents were asked to rank using the scale of 1 – 5 in order of effectiveness, critical success factors: **'1'** represents **Strongly disagree**, **'2'** represents **Disagree**, **'3'** represents **Neutral**, **'4'** represents **Agree** and **'5'** represents **Strongly agree**.

3.5 POPULATION AND SAMPLE FRAME

A set of individuals from whom a measure is taken refers to a population (Cooper et al., 2001). Again, Walliman (2011) is of the view that, a population does not state any number of people, units or elements but instead a total number of a specific group of individuals, units or cases of relevance to the researcher. In this regard, the population for this study were project professionals of D1K1 construction firm in Accra.

3.6 SAMPLING TECHNIQUE AND SAMPLE SIZING

The targeted population, that is, the stakeholders in construction were selected using the purposive sampling and snowball method for questionnaires administration. The targeted group was; **building construction firms** including architects, quantity surveyors, and engineers specifically class D1K1 construction firms for their experience in waste management in major of their projects.

Some difficulties were encountered in assessing the population of the targeted stakeholders of construction and so snowball sampling technique was employed to eliminate the need for getting the population sizes of the various stakeholders.

In snowball sampling technique, through the social network, the initial respondents are enquired to nominate or refer participants that are eligible or are in the same category of the research under study. The process assumes the existence of a bond or link between the first respondent and others

within the same target population. This grants a series of referrals to be made within a circle of acquaintance (Berg, 1988).

The method was then applied by first acquiring at least one contact or location of each of the categories of the targeted population from Consar limited, in Accra. This guide was pursued to locate subsequent offices and sites for building contractors. In all, a total of 50 sample size was derived but out that, 31 responded to the survey.

3.7 PROCEDURE FOR COLLECTING DATA

The primary source of data for the research which was in the form of structured questionnaire designed to collect information from building professionals (Architects, Contractors, Civil engineers, Quantity surveyors and Project managers in D1K1 construction firms

The questionnaires were distributed personally to respondents mainly in the offices and in some cases where questionnaires were mailed to respondents. Through the distribution, some of the respondents, especially those who were unfamiliar with the concept construction debris, were taken through with some part of the literature review and the questionnaire before their responses were given. Care has to be taken to be as neutral as possible and eliminate bias and not turn their answers towards one particular direction, and answers given to questions posed impartially.

3.8 ADMINISTRATION OF QUESTIONNAIRES

The questionnaires were administered and in most cases a maximum of two days' duration was agreed to respond to the questions in the questionnaires. In other instances, I had the opportunity to talk with respondents who were less busy on the topic of construction waste management.

A total of 50 questionnaires were administered, of which all is sent to each of the stakeholders on the list of targeted respondents out of which 31 responds were obtained.

3.9 DATA ANALYSIS AND ANALYTICAL TOOL

Analysis as defined by the Cambridge advance learner's dictionary as the act of studying and examining something into details in order to discover more about it. Data analysis according to Strydom *et al* (2005), is explained as the process of searching for answers by means of interpreting collected data and results. The reason for data analysis is to breakdown raw data into a clear, simple and easy to understand form for the interpretation of result. Strydom et al, further explained that, raw data are difficult to explain hence it must first be described, analyzed and then results of analysis interpreted. This section will help find answers to research questions by the analysis of the quantitative data collected and the interpretation of result to help allow conclusion to be drawn.

For this study, information from respondent were gathered, grouped and enter into an analytical software called, Statistical Packages for Social Sciences (SPSS version 21). Descriptive statistical analysis instruments were utilized, where the mean and standard deviation of the various variables were determined and data presented on tables using MS excel. This helped to rank the respondents in order of priority.

3.10 CHAPTER SUMMARY

The main purpose of this chapter was to describe the research methodology involved in the gathering and collection of data for analysis. This chapter gives detailed information on the type of research strategy chosen and a description of the type of questionnaire which were used for the data collection. Analytical software used is the SPSS for data analysis with descriptive statistics as the analytical tool where emphasis was on the measure of central tendency

CHAPTER FOUR

DATA ANALYSIS AND DISCUSSION FOR FINDINGS

4.1 INTRODUCTION

The chapter basically focuses on the analysis of data collected from target respondents. The collected data is analyzed and interpreted using tables to address the key objectives and research questions stated in the chapter one. Descriptive statistical analysis instruments were utilized especially mean score ranking which deals the various objectives and the respondent profile. The analytical results have been shown in tables and interpreted accordingly. Other analyses such as Cronbach's Alpha coefficient test utilized in assessing scale validity.

4.1.1 Survey Response

A total of 50 questionnaires were distributed to D1K1 construction firms in Ghana. From the gross distributed number, 31 were collected from respondents. The questionnaires were distributed to firms such as Berock limited, Consar limited, Antartic limited, Micheletti and many others. Purposive and snowball sampling technique was adopted in locating the targeted respondents.

4.2 DEMOGRAPHIC DATA ANALYSIS (RESPONDENT)

4.2.1 Respondent Field of Expertise

A respondent field of expertise is very relevant to the study as it helps determine the quality of information being produced. This help the researcher to know if the right respondents are answering the questionnaires. From Table 4.1, it could be seen that, contractor recorded the highest score of 35.5% followed by project manager, Quantity Surveyor with Civil engineers recording the least recorded with a percentage of 9.7.

4.2.2 Number of Years in The Construction Industry.

The duration of years the individual worked within building industry according to the researcher will contribute to the quality of information being produced by them. From the data collected, respondents with an experience of less than 5 years recorded the highest with 45.2%, followed by 5-10 years of experience with a percentage of 35.5% Respondents with 11-15 years' experience and over 15 years of experience recorded the least with a percentage of 9.7.

4.2.3 Knowledgeable on the Concept of Waste Management

This section was requisite in determining the degree of knowledge of the target group. Due to the practicality of the research topic, the depth of respondent knowledge is very important to the research study. From table 4.1, it could be seen that, majority of the respondents recorded "Yes" with a frequency of 29 to the knowledge of the concept of waste management. Whereas, a total of 2 recorded "No" to their knowledge on the concept of waste management.

4.2.4 Organizational Practice of Waste Management Principles

With this question, the researcher intended to identify if the organization of the respondents practice waste management practice. From table 4.1, 96.8% of the respondent agreed to their organization practicing waste management principles. Whereas, 3.2% indicated the absence of waste management practice in their organization.

4.2.5 Period of Practicing Waste Management

The duration of the company in practicing waste management principle will contribute to the depth of personnel's knowledge in waste management principles. From the table, it could be seen that, majority of the respondent recorded over 7 years of company's experience with a frequency of 10,

followed by 4-6 years of company's experience recorded a frequency of 7. The least recorded organizational experience is less than 2 years with a frequency of 5.

Table 4.1 Respondent profile

Respondent data	Frequency	Percent
Field of expertise		
Project Manager	10	32.3
Contractor	11	35.5
Quantity Surveyor	7	22.6
Civil engineer	3	9.7
Total	**31**	**100.0**
Years in the construction industry		
Less than 5 years	14	45.2
5-10 years	11	35.5
11-15 years	3	9.7
Over 15 years	3	9.7
Total	**31**	**100.0**
Knowledge of waste management		
No	2	6.5
Yes	29	93.5
Total	**31**	**100.0**
Does your company practices the waste management		
Yes	30	96.8
No	1	3.2
Total	**31**	**100.0**
Period of practicing		
Less than 2 years	5	16.1
2-4 years	7	22.6
4-6 years	9	29.0
Over 7 years	10	32.3
Total	**31**	**100.0**

Source: Field survey 2019

4.3 TO IDENTIFY THE USAGE OF CONSTRUCTION DEBRIS IN THE GHANAIAN CONSTRUCTION INDUSTRY

Respondent were asked to give their opinion by indicating the usage of construction debris in the Ghanaian construction industry. This was done by ticking the appropriate variable provided. The adopted scale was: 1=Strongly disagree, 2=Disagree, 3=Neutral, 4=Agree, 5=Strongly agree. was used in the Analysis of the data was undertaken with Mean scores and Standard Deviation in any case, Cronbach reliability utilized in assessing quality of results.

Reliability Statistics

Cronbach's Alpha	N of Items
.786	13

Source: Field survey 2019

The reliability score is 0.786 which is above the stipulated threshold of 0.700. This indicate that, the internal consistency of the scale.

After the reliability test, the identified variables in literature are analyzed, tabulated and interpreted as found below.

Table 4.2 Usage of Construction Debris

	Mean	Std. Deviation	Ranking
Construction debris are used for land reclamation	3.77	.717	1st
Construction debris are disposed at landfills	3.74	.893	2nd
Construction debris are reused as backfilling material on construction site	3.71	1.101	3rd
Construction debris are used for filling materials on construction site	3.65	.877	4th
Construction debris are transported offsite as waste material	3.55	1.179	5th
The Ghanaian construction sometimes use construction debris as pavement surfacing	3.52	.851	6th
Construction debris are utilized as compost	3.00	1.438	7th
Construction debris are recycled into new construction item	3.00	1.291	8th
Construction debris recycled are most used in Ghanaian construction site	2.77	1.023	9th
Construction debris are burnt	2.77	1.257	10th
Construction debris are recycled into fibers	2.68	.909	11th
Construction debris are avoided by the Ghanaian construction industry	2.65	.798	12th
Construction debris are used as concrete aggregates	2.61	1.256	13th

Source: Field Survey (2019)

Out of the 13 variable identified, 8 variables were ranked significant by respondents. That is to say, mean score between the range of 4-3 is considered important and most common practices. Variables such as; the use of construction debris for land reclamation was first with mean 3.77 standard deviation 0.717. next, the deposition of construction debris at landfills with a recorded mean 0.893 standard deviation 0.893. Construction debris are reused as backfilling material on construction site was ranked third with mean 3.71 standard deviation 1.101. Construction debris are used for filling materials on construction site and ranked fourth with a mean 3.65 standard deviation 0.877. The transportation of construction debris offsite as waste material came fifth with a mean 3.55 standard deviation of 1.179. The use of construction debris as pavement surfacing came sixth with mean 3.51 standard deviation of 0.851. Construction debris utilized as deposit and recycling of construction debris into a new construction item both had a mean score of 3.00 and a standard deviation of 1.438 and 1.291 respectively. Factors such as burning of construction debris, recycling of construction debris into fibers, Ghanaian construction industries avoiding construction debris, the usage of construction debris concrete aggregates had mean scores of 2.77, 2.68, 2.65 and 2.61. Hence, are tagged as not very significant.

4.3.1 DISCUSSION OF THE FIRST THREE VARIABLE.

Construction Debris Are Used for Land Reclamation

Construction debris according to respondents are used as land reclamation. Construction debris are generated from a wide range of source such as unwanted materials, rock and soil, waste asphalt bricks, concrete, plasterboard, timber and vegetables, asbestos, and contaminated soil (11). The construction industry contributes greatly to the production of waste. Rameezdeen (2014), added that, construction waste is generated from many sources right from the inception to the end of the project. However, the reclamation of land using these waste materials will help in reducing the

harm they cause to the environment. Land reclamation is basically explained as the restoration of land degraded by human activities or impaired by natural. Respondent were of the view that, in Ghana the most utilized means of construction debris generated on site is it usage for land reclamation.

Construction Debris Are Disposed at Landfill

Respondent also ranked this variable second level of utilization of waste in the Ghanaian building sector. In Ghana, there are policies guiding the construction and management of landfill site such as the Local Government Act of 1994 (Act 462). This shows the level of relevance landfill is to the country hence the encouragement of the construction industry to enter into it. The use of construction debris from construction site for landfilling is very essential.

Construction Debris Are Reused as Backfilling Material On Construction Site

Again, target respondents were of the view that, construction debris are used as mostly by the construction industry for backfilling on site. Backfilling is simply explained as the refilling of trench sides after an excavation and foundation works. According to respondents, construction debris are sometimes most often used as backfilling on construction site. Waste generated specially from concrete and mortar are reused through backfilling on construction sites.

4.4 TO DETERMINE CHALLENGES OF USAGE OF DEBRIS IN THE GHANAIAN CONSTRUCTION INDUSTRY.

With this objective, possible variables of challenges were identified from literature. The variables were given to respondents to give their opinion by ranking to the Likert scale provided. The measure used is as follows; 1= Not at all, 2=Slightly True, 3=Moderately True, 4=Mostly True, 5= Completely True. Descriptive statistics in particular, mean score was utilized in analyzing of

the data collected. Cronbach reliability statistics tested and checked the internal consistency of the measure.

Reliability Statistics	
Cronbach's Alpha	N of Items
.844	12

Source: Field Survey 2019

From the statistics, it could be noted that the reliability score more than the 0.700 which is the threshold. Thus, the inherent consistency is accurate.

Following this, the identified variable ranked by the respondent are test and result tabulated and interpreted as follows.

Table 4.3 Challenges

Challenges	Mean	Std. Deviation	Ranking
The use of wrong technique on construction site affect debris management	3.74	.815	1st
The poor management of construction site	3.71	.643	2nd
Lack of experience in managing construction debris	3.68	.871	3rd
Wrong usage of construction materials affects the management of debris from site	3.61	.803	4th
Inadequate planning and scheduling	3.58	.848	5th
Absence of waste management expert to properly manage construction debris	3.55	.850	6th
Lack of knowledge for the use of construction debris	3.48	1.262	7th
Variation during construction affect the use of construction debris	3.48	.769	8th
Mistakes during construction affect the reuse of construction debris	3.45	1.028	9th
Excessive movement of workers on construction site affect the management of debris	3.35	.915	10th
Excess production of waste during affect their management	3.29	1.006	11th
The increased number of unskilled labour affect the management of debris	3.16	.934	12th
Unnecessary movement of construction materials on site affect the management of debris	3.00	1.183	13th

Source: Field survey 2019

The result from the analysis revealed that, the use of wrong technique on construction site affect construction debris management and this variable ranked top with mean 3.74 standard deviation 0.815. The other variables were ranked in other of priority: poor management of construction site, lack of experience in managing construction debris, wrong usage of construction materials, inadequate planning and scheduling, absence of waste management expert, lack of knowledge for the use of construction debris, variation during construction, Mistakes during construction, excessive movement of workers, excess production affect management, the increased number of unskilled labour, unnecessary movement on site. All of the variables were ranked most significant due to the fact that, their means were 3 and above with a standard deviation also below 1.00.

4.4.1 DISCUSSION OF THE FIRST THREE VARIABLES.

Use of Wrong Technique

The use of wrong technique according to respondents is the major challenge of construction waste management. This can result as a result of the lack of experience of the worker in the industry. The limited capacity or ability of workers on site result in the usage of wrong techniques. Lu et al, (2011) added that, a reinforcement work handled by inexperience steel enders is the major cause of reinforcement waste. This statement is very true and cuts across the other activities on site. Nazech et al (2008) equally asserted to the fact that, the inexperience field supervisor contributes greatly to waste generation in the industry.

Poor Management of Construction Site

According to respondents, the poor management of construction site affect the waste management on construction site. Respondents were of the view that, the inability of some construction site to properly manage their activities on site serve as a great challenge to waste management on site. Lack of appropriate management and supervision contribute greatly to misappropriation on sit

hence resulting in increase in waste generation. Wang et al. (2008) asserted to this by adding that, the lack of supervision is a key reason of substantial amount of waste generation on construction sites.

Lack of Experience in Managing Construction Debris

This variable was third ranked according to respondents. The lack of experience in managing construction debris by stakeholders especially the consultant and contractor will affect the production of waste positively. The experience and expertise to execute waste management on site according to respondents is one of the major cause of waste production on site. According to Wan et al. (2009) the inexperience of foremen add to more defective works in Hong Kong construction industry. This however is not very different in the case of the Ghanaian construction industry

4.5 TO IDENTIFY CRITICAL SUCCESS FACTORS FOR UTILIZATION OF CONSTRUCTION DEBRIS IN THE GHANAIAN CONSTRUCTION INDUSTRY

Target respondents were asked to indicate their opinion on this objective by ticking these variable identified in literature in accordance to their degree of significance on a five point Likert scale. The scale is as follows: 1=Strongly disagree, 2= Disagree, 3=Neutral, 4=Agree, 5= Strongly agree. These analysis utilized mean score approach. However, the reliability of the internal scale is first checked using Cronbach Alpha.

Reliability Statistics	
Cronbach's Alpha	N of Items
.758	12

Source: Field Survey 2019

From the reliability statistics, it could be seen that, the value gotten is above the threshold of 0.700. Hence, the scale is internally consistent.

After the reliability test, the identified variables are analyzed and tabulated for interpretation.

Table 4.4 Critical success factors

Critical success factors			
	Mean	Std. Deviation	Ranking
Incorporating site waste management planning during the design stage	4.48	.508	1st
Government support for the usage of construction debris through legislation	4.42	.886	2nd
Workshop training on the usage of construction debris	4.26	.631	3rd
Effective planning of construction process	4.19	.910	4th
Incentive for the management and usage of construction debris	4.06	.680	5th
Standardization of recycled construction debris	4.06	.814	7th
Training of workers on waste productive procurement	4.03	.657	8th
Improvement of design practices also encourage the usage of construction debris	4.00	.730	9th
Design for adaptability and deconstruction	3.97	.605	10th
Proper supervision on construction site	3.97	.875	11th
Advising client on the benefit of recycled waste	3.84	1.214	12th
Management training contractor	3.74	.682	13th

Source: Field survey 2019

The result from the table revealed that, incorporating site waste management planning during the design stage ranked with mean of 4.48 standard deviation 0.508. The remaining variable were ranked in order of significance that is: Government support for the usage of construction debris through legislation, workshop training on the use of construction debris, effective planning of construction process, incentive for the management and usage of construction debris, standardization of recycled construction debris, Training of workers on waste productive procurement, improvement of design practices also encourage the usage of construction debris, design for adaptability and deconstruction, proper supervision on construction site, Adequate client on the benefit of recycled waste and lastly, the management training contractors.

4.5.1 DISCUSSION OF THE FIRST THREE VARIABLES

Incorporating Site Waste Management Planning During the Initial Stage.

Respondents were of the view that, for a success implementation of waste management, incorporating the waste management plan during the initial stage of the contract will help in its minimization. According to Coventry and Guthrie (1998), by addressing issues faced during the design process which could help facilitate better coordination at projects level could help in handling design waste. Enforcing waste management planning at the initial stage of the contract could guide the stakeholder's n activities to reduce waste production on site.

Government Support

Respondent were of the view that, the support of government through the enactment of policies, legislation and incentives will help in addressing the issue of waste management. According to the respondents, the government has a major role to play in the reduction of waste generation. The government of New South Wale, Australia in the year 2000 proposed to achieve a waste reduction

of 60% by making reforms to them exist Waste Disposal Act (Faniran and Caban,1998). Effective implementation of policies and legislation.

Workshop Training on the Usage of Construction Debris

Respondents were of the view that, frequent workshop training on ways of managing waste effective will help improve the application of waste management in our industries. Consistent training of personnel on the usage of construction waste after its generation will also help add value to them. Waste management has a low priority during construction project and not enough is done to reduce them (Teo and Loosemore, 2001). This is arising as a result of the lack of adequate knowledge and understanding of the concept. Hence adequate education through workshop will help encourage the practice of waste management thus, reducing it to a minimum.

CHAPTER FIVE

CONCLUSION AND RECOMMENDATION

5.1 INTRODUCTION

This chapter is geared towards summarizing the findings of the research and the aim and objectives. The conclusion, relevance and contribution of study is also underlined in this chapter. Further, limitation of the research and suggestions for future research directions are provided as well. This research was carried out to explore construction and demolishing waste usage in the Ghanaian Construction Industry. The research was carried out in five distinct chapters, for ease in understanding. The beginning chapter was an exploratory look into the background of the study. Through this, a problem was identified and aim of the study outlined by the researcher. Research questions and objectives of focus were also indicated coupled with the basic justification of the study and its importance to academia and industry at large. Methodologies to be employed, scope of study, a graphic representation of the study framework highlighted.

A literature review constituted the second chapter. Here, a dive into past literature was conducted to assist the assessment of developments made by researchers ahead of this study. A thorough review of books, thesis both published and unpublished, journals, and much relevant sources was conducted provide insights on the views of researchers on the ways of using construction debris, challenges to the usage of debris and critical factors which could be implemented for proper utilization of construction debris.

The methodology chapter was streamlined to provide insights on the framework of realizing the objectives set out pursuant to the study. It details the design of the study, the strategies utilized,

the philosophy guiding the study, development of questionnaire, sample and techniques of sampling, distribution, retrieval and procedural analysis of the collated data

The Fourth chapter sort to show the analysis conducted in realization of the objectives. It discussed the analytical instruments and tools employed as seen fit to each objective. A discussion of identified patterns and trends and relevant rankings of concern were done.

The Final chapter seeks to summaries the preceding chapters highlighting issues of key concern and the progress of the study thus far. It briefly gives a background to each objective and follows up on the deductions made after the investigation to the problem. Recommendations are then deduced from resultant information and the limitations which give rise to prospective areas of study are outlined.

5.2 FINDINGS

The aim of the research is to explore construction and demolishing debris usage in the Ghanaian Construction industry. In order to achieve this objective, three objectives were derived. The achievement of this objectives is as follows;

5.2.1 To identify the usage of construction debris in the Ghanaian Construction Industry

In achieving this objective, extensive literature pertaining to this objective was reviewed to check what scholars, researchers, and authors were discussing around construction debris. Thirteen objectives were identified in all. Target respondents were asked to rank their view in accordance to the practice in the Construction Industry. Mean score ranking and standard deviation was adopted for the data analysis. After analysis, it was noted that almost all the variables were practiced by the industry. However, some activities were classified more significantly practiced due to their mean score value. These activities have been ranked in order of extremities as follow; the use of construction debris for land reclamation, the deposition of construction debris at

landfills, Construction debris are reused as backfilling material, Construction debris are used for filling materials on construction site, The transportation of construction debris offsite as waste material, The use of construction debris as pavement surfacing, Construction debris utilized as deposit and recycling of construction debris into a new construction item. The variable considered not most practiced are; burning of construction debris, recycling of construction debris into fibers, Ghanaian construction industries avoiding construction debris, the usage of construction debris concrete aggregates.

5.2.2 To determine the causes of debris in the Ghanaian Construction Industry.

For the second objective, several literature relating to the challenge of debris usage in the construction industry were identified and adopted for the survey. Thirteen variables were identified in all. Respondent were then asked to rank in accordance the how the challenges are experienced in their firms. Mean score ranking was used in the analysis and ranked in order of priority. After the analysis, it was realized that, the use of wrong technique on construction site affect construction debris management. Followed by the other variables ranked in other of priority: poor management of construction site, lack of experience in managing construction debris, wrong usage of construction materials, inadequate planning and scheduling, absence of waste management expert, lack of knowledge for the use of construction debris, variation during construction, Mistakes during construction, excessive movement of workers, excess production affect management, the increased number of unskilled labour, unnecessary movement on site.

5.2.3 To identify critical success factors for utilization of construction debris in the Ghanaian Construction Industry

With this objective also, necessary literatures relating to it were reviewed thoroughly to identify critical success factors for utilization. Thirteen variable were identified in all and these variable

were given to respondent to rank in order of effectiveness. Mean score and standard deviation was used for the analysis of the data retrieved. After the analysis, it was seen that; incorporating site waste management planning during the design stage was ranked first. Followed by, Government support for the usage of construction debris through legislation, workshop training on the use of construction debris, effective planning of construction process, incentive for the management and usage of construction debris, standardization of recycled construction debris, Training of workers on waste productive procurement, improvement of design practices also encourage the usage of construction debris, design for adaptability and deconstruction, proper supervision on construction site, Adequate client on the benefit of recycled waste and lastly, the management training contractors. These variables are listed in order of priority and effectiveness. All variables were indicated significant after the analysis, as they had a mean score above 3 and standard deviations below 1.0.

5.3 CONCLUSION

With the first objective, it was identified that most of the variables were used by the construction industry as a means of waste management. The first three variables were; the use of construction debris for land reclamation, the deposition of construction debris at landfills, Construction debris are reused as backfilling material. Respondent were in most agreement to this variable as most used method for construction debris utilization.

On the second objective, the result of the survey also revealed some relevant variable the hinders the usage of construction debris such as, poor management of construction site, lack of experience in managing construction debris, wrong usage of construction materials. However, the use of wrong technique on construction site affect construction debris management was the most challenging variable according to respondents.

With the third objective, variables such as; incorporating site waste management planning during the design stage was ranked first. Followed by, Government support for the usage of construction debris through legislation, workshop training on the use of construction debris, effective planning of construction process. These variables were identified as most significant after the analysis.

5.4 CONTRIBUTION TO KNOWLEDGE

Generally, it was revealed that, construction debris are utilized by the construction industry, however, these wastes are not effectively utilized due to some challenges identified. The study further went ahead to identify strategies to help in optimizing the use of construction debris on site.

So therefore, this study has brought to light the various usage of construction debris on site by large construction firm specifically.

Lastly, the study has identified some critical success factors to help in the maximization of waste management in the industry.

5.5 RESEARCH LIMITATION

The major limitation encountered in this study was data collection and sample size determination. In this study, the targeted population for the survey was D1K1 construction companies. However, it was difficult getting the total population of D1K1 construction firms in Accra. Hence a qualitative method was adopted. Again, the professionals in the industry were my main target respondent and getting them to answer questionnaires was a difficult task. This is as a result of their busy schedule and this resulted in the difficulty of retrieving data from the respondents. But the few who made time to answer the questionnaires were of great help to the study

5.6 RECOMMENDATIONS

In order to optimize the usage of construction debris in the construction industry;

- There should be adequate education through workshop training. This should be organized for construction professionals to broaden their cope of knowledge on waste management principles and technique.
- The support of Government through policies and legislation will help in improving the usage of construction waste.
- The implementation of the strategies identified in the third objectives will help in reducing construction waste.

5.7 DIRECTION FOR FUTURE RESEARCH

During the course of the study, one research area was identified as open opportunities for further investigation. The following direction is suggested for future studies;

1. Strategic ways of implementing the identified measures of construction debris usage on construction site

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APPENDIX

Kwame Nkrumah University of Science and Technology

Department of Construction Technology and Management

Accra

Dear Sir/Madam

An invitation to partake in a research survey

I am undertaking a research study in KNUST as part of my partial fulfillment of the award MSc Construction Management. The Topic of my research is: Assessing the usage of Construction and Demolishing Debris in the Ghanaian Construction Industry. The main objectives of the research are:

1. To identify the usage of construction debris in the Ghanaian Construction Industry
2. To determine challenges of usage of debris in the Ghanaian Construction Industry.
3. To identify critical success factors for utilization of construction debris in the Ghanaian Construction Industry.

Attached is a copy of my questionnaire. I will be very grateful if you could answer this questionnaire to aid the study. **All information collected will be confidential and would be used only for academic purposes.** Thank you for your time and contribution in advance.

Yours faithfully
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PART ONE: RESPONDENT PROFILE

Please select from the alternatives provided that best answers for the questions below

1.What is your field of expertise

[ ] Project Manager [ ] Quantity Surveyor

[ ] Contractor [ ] Civil engineer

[ ] other (Specify)…….

2. How many Years have you been in the construction industry.

[ ] Less than 5 years [ ] 11-15 years

[ ] 5-10 years [ ] over 15 years

3.Are you knowledgeable on the concept of waste management.

[ ] No [ ] Yes

4.Does your organization practice waste management principles.

[ ] Yes [ ] No

5.For how long has your organization been practicing waste management.

[ ] Less than 2years [ ] 4-6 years

[ ] 2-4 years [ ] Over 7 years

PART TWO

A. TO IDENTIFY THE USAGE OF CNSTRUCTION DEBRIS IN THE GHANAIAN CNSTRUCTION INDUSTRY

The table below shows some factors identified in literature under the usage of construction debris in the Ghanaian Construction Industry. Select from the various factor the ones in your opinion are practiced on construction project in Ghana. A rating scale of 1=Strongly disagree, 2=Disagree, 3=Neutral, 4=Agree, 5=Strongly agree is adopted. Please answer by ticking in the corresponding boxes.

No	CONSTRUCTION DEBRIS	1	2	3	4	5
1	Construction debris are recycled into fibers					
2	Construction debris are recycled into new construction items					
3	Construction debris are reused as backfilling materials on construction site					
4	Construction debris are used for land reclamation					
5	Construction debris are disposed at landfills					
6	Construction debris are burnt					
7	Construction debris are transported offsite as waste material					
8	Construction debris are avoided by the Ghanaian construction industry					
9	Construction debris recycled are mostly used in Ghanaian construction site					
10	Construction debris are utilized as compost					
11	Construction debris are used as concrete aggregates					
12	Construction debris are used for filling materials on construction site					
13	The Ghanaian construction sometimes use construction debris as pavement surfacing					
	If any other, please state and rank					

SECTION B: CHALLENGES OF USE GENERATION OF DEBRIS IN THE CONSTRUCTION INDUSTRY.

The table below shows some factors established in literature as challenges to the use of debris generation in the construction industry. Rank these factors in order of relevance in your experience by ticking.

Scale: 1= Not at all, 2=Slightly True, 3=Moderately True, 4=Mostly True, 5= Completely True

No	FACTORS	1	2	3	4	5
1	The poor management of construction site					
2	Lack of experience in managing construction debris					
3	Absence of waste management experts to properly manage construction debris					
4	Inadequate planning and scheduling					
5	Variation during construction affect the use construction debris					
6	Mistakes during construction affect the reuse of construction debris					
7	Lack of knowledge for the use of construction debris					
8	Excess production of waste during affect their management					
9	The increased number of unskilled labour affect the management of debris					
10	Unnecessary movement of construction materials on site affect the management of debris					
11	Excessive movement of workers on construction site affect the management of debris					
12	The use of wrong technique on construction site affect debris management					
13	Wrong usage of construction materials affects the management of debris from site					
	If any other, please state and rank					

SECTION C: CRITICAL SUCCESS FACTORS FOR UTILIZATION OF CONSTRUCTION DERIS IN THE GHANAIAN CONSTRUCTION INDUSTRY.

Rank the following in order of importance according to your opinion and experience by ticking the corresponding boxes.

Scale: 1=Strongly disagree, 2= Disagree, 3=Neutral, 4=Agree, 5= Strongly agree

No	FACTORS TO CONSIDER	1	2	3	4	5
1	Advising client on the benefit of recycled waste					
2	Workshop training on the usage of construction debris					
3	Improvement of design practices also encourage the usage of construction debris					
4	Contract and legal binding agreement with stakeholders on construction debris encourage their usage					
5	Standardization of recycled construction debris					
6	Management training for contractor					
7	Effective planning of construction process					
8	Government support for the usage of construction debris through legislation					
9	Proper supervision on construction site					
10	Incentives for the management and usage of construction debris					
11	Training of workers on waste productive procurement					
12	Design for adaptability and deconstruction					
13	Incorporating site waste management planning during the design stage					
	If any other, please state and rank					

Any additional comment can be indicated below

……
……
……
……

THANK YOU!!!