WASTE MANAGEMENT PRACTICES OF REAL ESTATE FIRMS

By

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DECLARATION

I hereby declare that this submission is my own work and that, to the best of my knowledge and belief, it contains no material previously published or written by another person material which to a substantial extent has been accepted for the award of any other degree or diploma at the Kwame Nkrumah University of Science and Technology, Kumasi or any other educational institution, except where due acknowledgement is made in the thesis.

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ABSTRACT

Waste management remain a serious challenge globally, with huge sums of money spent towards managing waste across the globe. Available statistics indicate that local governments in Africa are currently spending about US$15 billion per year on urban solid waste management. This substantiate the need for effective waste management practices among the real estate firms, since it is anticipated that, by 2025 the spending on solid waste management activities would have increased by 200 per cent. The study specifically looked at the significant waste management practices adopted by real estate firms and the challenges and problems local real estate firms face on construction waste management practices. To achieve these objectives, the researcher adopted the mixed method survey design approach and research questionnaire as data collection instrument. A sample of thirty (30) respondents were sampled across thirty (30) real estate development firms in the greater Accra region using non-probability (Judgmental sampling) sampling technique. Findings from the study revealed that, Waste Re-use is the significant waste management practice among real estate developers ranked first (1^{st}) with a mean score of 4.38, this followed by Waste recycling with a mean score of 4.22. The least ranked waste management practice was however, Waste disposal with a mean score of 3.12. On the waste management practice used locally by real estate firms, findings revealed that most of the real estate developers in the Greater Accra region uses Waste Re-use, followed by waste recycling, and waste disposal with waste minimization being the least waste management practice used among real estate developers. Finally, on the challenges and problems of waste management practices, findings revealed that, the major challenges faced in waste management practice is inability of EPA to fully discharge their supervisory role to ensure that certain principles are adhered to in waste management and to provide waste management policy. It was followed by high cost of waste management and inadequate skilled labor on waste management which attained 60% endorsement from the respondents leaving lack of commitment on the part of project management to be last with 53.3% of agreement level by respondents. Based on these findings the researcher recommends, it is recommended that the EPA provides a Waste Management Plan or policy and to monitor to ensure that construction industry players adhered to best practices.

Keywords: Disposal, Demolition, Disposal**,** Minimization, Reuse, Recycling**,** Waste

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CHAPTER ONE

INTRODUCTION

1.1 Background of the Study

Globally, waste volumes are increasing quickly, even faster than the rate of urbanization. According to Hoornweg and Bhada-Tata (2012), the world cities are currently generating about 1.3 billion tonnes of solid waste per year. This volume is expected to increase to 2.2 billion tonnes by 2025 Moya et al. (2017). As countries urbanise, their economic wealth increases. As standards of living and disposable incomes increase, consumption of goods and services increases, which results in a corresponding increase in the amount of waste generated (Hoornweg and Bhada-Tata, 2012).

According to Amoo and Fagbenle (2013), "available statistics indicate that local governments in Africa are known to be spending about US$15 billion per year on urban solid waste management currently". This figure is used in collection of averagely not less than "90 percent of the waste in high -income countries, between 50 to 80 percent in middle -income countries, and only 30 to 60 percent in low-income countries" Amoo and Fagbenle (2013). It is anticipated that, "by 2025 the spending on solid waste management activities would have increased by 200 per cent" (Hoornweg and Thomas, 2013).

Although solid waste is generated by different household and economic activities, the construction industry has always been considered as one of the major producers of waste (Al-Hajj and Hamani, 2011). Construction waste is not by nature an environmentally friendly substance; the sector has always been a major generator of construction waste (Lachimpadi and Mokhtar 2012; Shen and Tam, 2012). Construction waste reduction is important not for the perspective of efficiency only, but also concerns growing in recent years about the adverse

effect on the entire cost of a building the buildings and on the environment. This kind of waste typically "accounts for between 15 and 30% of urban waste generated annually" (Hoornweg & Bhada-Tata, 2012). Poon et al. (2014), defines construction waste as the debris generated through construction activities either by demolition of already existing structures/building or leftover/unused concrete slaps and woods at construction sites. They indicated that, managing waste from construction comes with a lot of challenges to both the contractor and the client due to its complicated nature. Waste generated from construction site seem to be a mixture of several debris which make it very difficult to separate or recycle unlike solid waste from household activities.

Realizing the negative impact of construction waste to the environment, governments at both national and international levels have introduced various policies and regulations to make construction activities more sustainable (Akadiri and Fadiya, 2013). The local industry on their part has also been promoting measures such as establishing waste management plans, reduction and recycling of construction and demolition wastes, providing in-house training on environmental management, and legal measures on environmental protection (Shen and Tam, 2012).

1.2 Statement of the Problem

More than half of the world's population currently live in cities, and a projected 70 percent will be living in urban areas by 2050 (UN-HABITAT, 2014). In the increasingly global and connected world, urbanisation is a global phenomenon. Natural population growth, economic growth, rapid urbanization, immigration and rural urban drift has changed the spatial configuration of most cities in the world. According to the United Nations (2014), the world

population has grown rapidly since 1950, ranging from 746 million to 3.9 billion as at 2014. Asia, despite its low level of urbanization is about 53 per cent of the world's urban population which is followed by Europe being 14 per cent, the Caribbean and Latin America being 13 per cent. Africa is urbanizing at a very fast rate. Its urbanization soared from 15 per cent in 1960 to 40 per cent in 2010 and is projected to reach 60 per cent in 2050 (UN-HABITAT, 2010). This fast urbanization trend has called for the production of houses, roads, schools, hospitals and other infrastructure demands (Open Science Index, 2015). This demand consumes natural resources and also produces waste that consumes landfills.

In Ghana, housing supply is categorised into three; the self-built; private developers and the government (UN-HABITAT, 2006). The private developers of which real estate industry is inclusive is the second largest supplier of residential accommodation in housing sector. According to GREDA (2006) the real estate sector supply average 8% annually with chunk of the supply been self-incremental development from individuals. The housing demand of Ghana's capital city of Accra has brought about the upsurge in real estate developments. Currently over 80% of the developers are concentrated in Accra due to the ready market (Ghana Real Estates Developers Association 2012). These mass production and supply of housing has its own waste production that consumes landfills and resources as well.

The construction industry produces around 120 million tonnes of construction, demolition and excavation waste per year with only half of this currently being recycled or reclaimed (OMAN chapter, 2015). Due to the fast urban development, landfills are mostly rare and insufficient. In 0ne hand, allocation of certain sites for land filling these materials requires land ownership and money and on the other hand, due to the placement of landfills far urban areas, transportation costs will be included too (Mehrdad et al., 2015).

Waste that emanates from construction site has recently become a major problem to the nation due to its negative impacts on the environment. Noraziah, et al. (2015) hold the view that, huge amounts of construction waste will cause destructive effects on the environment if they are not managed properly.

In addition to its negative impact on the environment by generating waste, consuming landfills, and natural unrecoverable resources, construction project costs increase significantly due to the amount of waste (Shant and Koch, 2014). This significant increase in project cost increases the completed property prices since real estate developers are not charitable organizations and will like to achieve a desired profit margin.

According to a study by Sagoe (2011), "the construction of roads, houses, bridges or anything for individuals or the government, involves many resources". Available literature on this important subject matter has been limited largely to solid waste generated from the household activities and hence provides a research gap to be filled by this current study.

1.3 Research Questions

From the research objectives, the study seeks to examine the following research questions:

1. What are the significant waste management practices adopted by real estate firms?
2. What are the problems and challenges inherent in the waste management practices?

1.4 Aim of the Study

The main aim of the study is to assess the best significant waste management practices adopted by real estate firms and their challenges in the practices.

1.5 Research Objectives

The main purpose of the study is to assess waste management in the construction industry. Specifically, the study seeks

1. To assess the significant waste management practices adopted by real estate firms.
2. To examine the problems and challenges inherent in the waste management practices.

1.6 Significance/Justification of study

This study could not have been relevant to the real estate and the construction industry and Ghana at any period of time than now, considering the urbanization rate, the ready market for real estate development and the president of Ghana's vision to making the capital city the cleanness city in the African continent. The available literature has provided statistics to the alarming increasing nature of waste generated from the construction industry in Ghana and hence for this vision to be realized there is the need to consider the construction as well as the real estate industry as a key contribution factor to solid waste producers and formulate/enforce laws to help mitigate or end this menace.

On project cost escalation, this study seeks to draw the attention of real estate developers in the industry to appreciate the factors that sprout up the cost of construction so that they can reduce the waste level and as such improve on productivity and the final prices of buildings.

1.7 Scope and Limitation of the Study

The study was focused on building construction projects undertaken by private real estate developers within the Greater Accra region. The researcher assessed the waste management practices put in place by these real estate companies, considering the significant practices, challenges, possible adoption of best practices across the industry. The study cannot do away with constraints in coming out with the results. There are several estate development firms in the region and the study did not represent the entire population of these estate. Secondly time factor and resources has not permitted a carefully access to all firms for salient information.

1.8 Research Methodology

The study made use of both primary and secondary information. Other sources of information were from books, journals, pertinent articles, and published and unpublished dissertations of students. Primary data involved the use of self-administered questionnaires to industry player's (contractors and consultants). The questionnaire incorporated the use of close ended questions and a Likert scale to rate and answer questions pose to respondents. The questionnaires provided feedback on views/opinion of respondents about construction waste management at the project site and also all relevant question to provide answers to the research objectives. SPSS version 20.0 was used to analyse the data collected from the field.

1.9 Organization of the research

The study is organized into five chapters with the opening chapter presenting the background to the study, problem statement, research objectives as well as research questions etc. the second chapter presents the review of literature, presenting the theoretical and conceptual

framework which establishes the need for the study. The third chapter spells out the methodological steps that the researcher used to gather data and analyzed the data to make inferential interpretation. The fourth chapter presents the data analyzed and finally, the five chapter presents summary of findings, conclusion and recommendations.

CHAPTER TWO

LITERATURE REVIEW

2.1 Overview

This chapter explored all available previous studies on the subject matter. On this chapter, readers will be acquainted with existing studies relative to the issues covered in the study. It thus provides the theoretical framework for the study and partly establishes the need and relevance for the study. the literature review consists the following; overview of construction waste, concept of waste, factors influencing construction waste management, environmental impact of construction waste, classification of construction waste, environmental impact of construction waste and empirical review of construction waste.

2.2 Overview of Waste in the Construction Industry

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

Construction waste is hazardous to the environment (Begum et al., 2006; Chen et al. 2000; Teo and Loosemore 2001). The main types of construction waste include unavoidable waste (or natural waste); and avoidable waste (Formoso et al.1999). However, Ekanayake and Ofori (2000) classified construction waste into categories of material, labour and machinery waste. According to Environmental Protection Department (2000) material waste comprises

unwanted materials from construction emanating from rejected structures, materials ordered in excess; and discarded materials (Agyekum et al. 2012).

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

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

The investment required for the mitigation of unavoidable waste is greater than the economic benefits achieved while the cost of avoidable waste is higher than the cost of its prevention

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

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

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

(see for instance UNESCAP, 2009). Majority of these solid wastes emanating from the construction industry are mostly generated in urban areas (Mohd et al., 1998).

Wilson et al. (1998) identified the most solid materials which generate waste on site through handling as timber, metal, masonry and plasterboard and paper products. In addition, waste minimization through reuse and recycling are virtually non-existent in the construction sector and natural resources required as building materials are available at relatively low cost (Begun et al., 2009). Waste minimization efforts must start very early during the construction process (Al-Hajj and Hamani, 2011). Furthermore, there is lack of mandatory requirement for construction firms to observe the practice of sustainable resource and waste management practices (Begun et al., 2009). To reduce the mounting rate of waste management menace in the construction industry, construction industry regulatory bodies are required to develop the legal and regulatory framework through the formulation of "Construction Industry Master Plan" (Construction Industry Development Board, 2007). Similarly, waste management plans to aid contractors or project managers to forecast and keep record of amount of construction waste to be generated to help reduce the level of waste generation in the construction industry (WRAP, 2007). A study by Defra, (2009) revealed that construction waste management plan is aimed at improving materials resource efficiency by implementing reuse, recovery and recycling; and to minimize issues of illegal dumping by properly documenting waste removal processes. The construction waste management plan which commences during the pre-planning stage and throughout the duration of the project requires the cooperation of all parties involved in construction project delivery, notably the client, contractor, designer, engineer, subcontractors, workers and even the suppliers to ensure efficient and effective construction waste management. The construction waste management plan is mandatory in some

developed countries including England, Singapore; United States inter alia (LEED, 2004; BRE, 2009). It is also required to develop key performance indicators and training of staff in the crucial aspects of construction site waste management in the management of construction waste (Papargyropoulou et al. 2011). Monitoring, evaluation and reporting are also required during the duration of the entire construction waste management.

2.2 Waste Management Concepts

"The business of ensuring free environment from contaminants and effects of waste materials is generally termed waste management". "Gbekor (2003), for instance, has referred to waste management as involving the collection, transport, treatment and disposal of waste including after care of disposal sites". In relation to this, Gilpin (1996) also defined waste management as "purposeful, systematic control of the generation, storage, collection, transportation, separation, processing, recycling, recovery and disposal of solid waste in a sanitary, aesthetically acceptable and economical manner".

It is evident from literature that, the practice of waste management is aimed at protecting the environment from the polluting effects of waste materials in order to protect public health and the natural environment. Thus, "the priority of a waste management system must always be the provision of a cleansing service which helps to maintain the health and safety of citizens and their environment" according to Cooper, (1999).

Further studies by Gilpin (1996) regards the practice of construction waste management as a professional practice which goes beyond the physical aspects of handling waste. It also "involves preparing policies, determining the environmental standards, fixing emission rates,

enforcing regulations, monitoring air, water and soil quality and offering advice to government, industry and land developers, planners and the public" (Gilpin, 1996).

The work of Gilpin again opined that "Waste management, therefore, involves a wide range of stakeholders who perform various functions to help maintain a clean, safe and pleasant physical environment in human settlements in order to protect the health and well-being of the population and the environment".

2.4 Factors Influencing Construction Waste Management

Several reviewed literature has identified the factors influencing construction waste management. These factors encompass "changes in design, consideration of reducing construction waste in design, investing on construction waste management, regulations, guidelines, space needed to perform waste management on site, adoption of technologies, waste reduction cost and waste management culture within an organization" according to (Nagapan et al., 2012; Yuan 2013; SWCorp Malaysia 2015.)

2.4.1 Design Changes

Changes in design one of the most influencing factors of construction waste management according to (Ekanayake and Ofori 2000; Faniran and Caban 1998; Yuan 2013). "The design change can be identified as an error attributed to construction materials which have been purchased based on the original design". According to Yuan (2013) "after changes to design have been taken, the material can no longer be resold or returned to the suppliers or vendor and this situation contributes to the generation of waste".

2.4.2 Consideration of Construction Waste Reduction in Design

Literature from the various research has revealed that averagely "33% of waste generated in construction industry are related to project design errors" according to (Osmani et al., 2008). This indicates how big design errors can contribute to the construction waste from the early stage of construction. "To reduce the generation of waste in construction, well prepared design stage will directly reduce the possibility of waste generation in construction projects" (Innes, 2004). The study of (Jaillon et al. 2009; Yuan 2013) believe that in order to reduce and ensure proper waste reduction strategies, "best practices are taken into the design stage such as design for standard size and add the prefabricated or adopting modular and the involvement of all other professional team members in the process".

2.4.3 Regulation and Guidelines

A study by Puopiel (2010), reported that, the ever increasing number of generated construction waste year by year in Ghana is a result of no adequate enforcement measures are taking into consideration by the regulatory authorities, they also indicated that, focus or special regulation or guidelines to be followed by the construction industry is non-existence making the industry players very reluctant in acting right. In developed countries like Britain, Australia, Japan, and others country, they have specific guidelines and regulation for management of construction waste according to Puopiel (2010). "Considering the example of Japan which had adopted an integrated waste and material management approach that promotes dematerialization and resource efficiency". "The government's 'sound material cycle society' initiative launched in 2000 brought with it a number of new regulatory codes including specific laws targeting construction materials" (Ismam and Ismail 2014). "In 2002 Japan introduced the construction

waste recycling law, which has resulted in high rates of recycling". For example, 99% of concrete had been recycled in 2006. "The law enforces the recycling of a broad range of construction and demolition materials". "Demolition contractors are required to separate and recycle specific construction wastes such as concrete, asphalt, and timber" (Ismam and Ismail 2014)

2.4.4 Site Space for Performing Waste Management

In developing country, one of the methods for managing the construction waste in site, is to provide space for waste management. Site space refers to the space for sorting and segregation, handling and manage the waste. "Sorting at the construction site is widely useful as an effective way in achieving a higher rate of waste reuse and recycling" (Shen et al. 2007; Yuan 2013). "Developed country such as Hong Kong found that given site space as an important factor than the influence of systematic construction waste management" (Poon et al. 2001). Previous study also proves that on site waste sorting could increase the rate of reuse and recycling and directly reduce the logistic cost and dumping cost (Poon et al. 2001; Hao et al. 2008; SWcorp Malaysia, 2015).

2.4.5 Adoption of Technology

The study by Yaun (2013) reported that, "the use of technologies could help to reduce, reuse or recycle construction waste". "The implementation of technologies such as innovations in construction project will contribute to the generation of construction waste". Previous studies proved that the employment of technologies such as "prefabrication, IBS, innovation of formwork and others technologies can minimize the current practices of construction waste

management, the barriers of implementing construction waste management and the potential factor in implementing of construction waste management" according to (Yaun 2013).

2.4.6 Waste Management Culture

Culture of waste management is related to the human behavior such as awareness of construction parties to get involved in construction waste management according to Yaun (2013). It has been found that "the awareness of waste management among practitioners and construction parties can save the resources and protect the environment" according to (Shen et al. 2007; Yuan 2013). Study has been conducted by (Poon et al. 2001) for revealing the understanding of both managers and site workers about waste reduction. Furthermore, in 2006, study conducted by (Poon et al. 2006) proved that "assessing architects' view on the origins of design waste that can minimize the waste design practices in the UK". "Finding from this study shows that the awareness and attitudes of the practitioners and construction parties in waste management are big factors that contributes to the reduction of waste and waste management" according to (Poon et al. 2006).

2.5 Environmental Impact of Construction Waste

The construction industry plays an indispensable role in providing physical infrastructure to meet the growing societal needs. On the other hand, it brings about detrimental effects, such as various forms of environmental pollution and resources depletion (Ofori, et al. 2000). The environmental consequences generated from the construction industry relate to many aspects including: (I) of large amounts of energy consumption during the processing of materials, construction processes and in the use of constructed structures; (ii) dust and gas emission

released during the production and transportation of materials and in some construction operations; (iii) disruption of people living in the vicinity of construction projects through traffic diversion, noise pollution and others; (iv) production of substantial volumes of waste; (v) waste water discharge; (vi) use of water resources; (vii) pollution from building materials; (viii) land use and (ix) substantial consumption of both renewable and non-renewable resources (Clements 2000); (Morledge and Morledge 2001); (Poon et al. 2001).

Construction waste has recently become a serious environmental problem in many cities across the globe (Cheung et al.1993). "Many construction industries generate serious environmental impacts, as compared to other industries and yet it lags far behind in implementing environmental management guide that will help mitigate the negative impacts". "The construction industry is in charge of producing a whole variety of wastes, the volume and type of which depends on factors such as the stage on the construction cycle, type of construction work and construction practices on site. International studies have shown that the construction industry contributes significantly to resource and environmental mismanagement" (Cheung et al.1993). "Some of the available statistics from literature indicate that the construction and operation of the built environment accounts for: 12-16% of fresh water consumption; 25% of wood harvested; 30-40% of energy consumption; 40% of virgin materials extracted and 20-30% emissions from greenhouse" (Cheung et al.1993).

While the rapid economic demand creates the largest construction market in the world and brings about an unprecedented opportunity in the construction industry, Macozoma, (2002) stated emphatically that, "pollution resulting from construction activities has become a serious canker. It is stated from statistics that the annual solid waste from construction reaches 30-40% of the total urban solid waste in China".

Sorting and selection of construction waste materials also influence the environmental impact of construction. There are several factors that leads to high level of impact from wastes materials and the way they are processed. Similar materials can have greatly different environmental impacts depending on these factors. Factors considered as important in the influence of selection of residential construction materials are based on their durability compared to intended life span, lifecycle energy embodiment, source and environmental impact of all component materials and processes, recycling potential, and distances with respect to transfer of material components.

The current increase in the volume of waste in the construction industry contributes to the rapid depletion of green vegetation and most of the pollutants from air, water and other ecosystems. Water pollution among others will also result from the materials extraction process. When material ends up as waste it can be reused or recycled thereby minimizing and reducing the impact on the environment through less processing and less energy usage. The construction industry is considered to be the biggest consumer of raw material in the UK, about 90% of non-energy minerals extracted in Great Britain are used for construction materials 260m tonnes of material are extracted for use as aggregate and other construction material.

Waste contains embodied energy as cited by (Treloar et al. 2003) in Boustead and Hancock (1979) which is "the energy consumed during extraction, processing, manufacture and transportation at all stages of the cycle". When material is recycled the embodied energy within that material means there will be less energy needed in processing it.

According to (Burnley 2007) National Waste Management Strategy can simple change the management and production processes can aid in the use of new innovations can save the

amount of waste being generated and the amount of energy being used. It is also clear from available literature that, construction of buildings, their materials and occupant's use of services is responsible for 50% of CO2 emissions in the UK. A push for more sustainable construction is required as the Government has targets for a 60% reduction in emissions by 2050 less than the 1990 levels. Metal, glass and hard wood timber have a high embodied energy. Mostly, reuse and recycling is given high priority towards waste minimization. By using reclaimed and recycled materials, 70% of embodied energy can be saved. This could result in cost savings of about 40% of the building price,

Gypsum is known to be harmful at dumpsite as a result of leaching of substances such a sulphates into the ground, this is harmful to humans if it contaminates water bodies. Gypsum records "the largest portion of the non-inert waste in the UK, at 36%, of the waste stream at construction sites" according to (Burnley 2001).

2.6 Classification of Construction Waste

It is very well recognized that the construction industry is not environmentally friendly. A part from consuming large amount of natural resources, it has been criticized to generate high level of solid waste. (Amaratunga 2006) argued that construction sector consumes averagely 25% of virgin wood and 40% of raw stone, gravel and sand globally every year. Duke (2001) also stated that "other than solid waste; poor quality that causes re-work, material double handling, schedule delays, commuting within the job, waiting for decision and poor constructability are considered other types of construction waste". "Construction waste can be grouped into two principle components"

i. Time wastes which includes waiting periods, stoppages, clarifications, variation in information, rework, ineffective work, delays in plan activities, and abnormal wear of equipment.

ii. Material wastes comprising over ordering, overproduction, wrong handling, wrong storage, and manufacturing defects.

The waste produced by the burning trash furnaces includes more than 200 different dioxin compounds and generates large amount of CO2 emission. Demolition wreckage and package waste may be categorized in three groups in the construction process. Due to the variety of activities on construction sites, construction waste may include plywood, platform, brick, paint, metal, copper, aluminium, concrete, electrical cable, rebar, paper, plastic, electrical device, steel, and much more.

2.7 Empirical Review of Construction Waste

Farmoso's research (2002) in Hong Kong conducted on 32 construction buildings since June 1992 to February 1993. The research aimed to reduce the higher waste material in the future and the impact to the environment, the waste material found was 2.4% to 26.5% of the material purchased. The research in the Netherland conducted on 5 house residential buildings since April 1993 to June 1994 (Bossink and Browers, 1996). The research concluded that the waste material found was 1.0% to 10.0% of the material purchased, the waste material caused by mainly from the design phase, material supply, poor material handling and storage. The research also conducted in Australia on 15 residential buildings (Forsythe and Marsden, 1999). The waste material found was 2.5% to 22.0% of the material purchased; this research provided the cost model of waste material occurring in the project. The research in Brazil

conducted on 3 residential buildings since 1986 to 1987 (Pinto and Agopayan, 1994). The research found that waste material was 11.0% to 17.0%.

(Rani 2017) conducted the assessment to the waste material in housing construction in Tanjung Bunga Area, Makasar based on waste material resource criteria and works causing waste material. The analysis output showed that the cement material had the highest waste value which was the main resources came from the residual of the stucco work, the waste for the wood material came from the residual of the formwork, the waste for the ceramic especially came from the residual of tilling work size 30x30, the waste for the brick material mainly came from the mishandling in the wall construction work, the waste for the paint material come the mishandling in the basic painting work (meni), for the iron material waste came from the measurement error. This research also gave the solution for the waste material reduction effort and the recommendation for the waste material coefficient that can be used in the next project phase.

(Suryanto 2004) conducted the research on the analysis and evaluation of the waste material in store project construction in Surabaya. The research aimed to detect waste material quantity and causing factors, then categorized the waste material into direct waste and indirect waste, and proposed a cost model for waste material in the store construction. The research data was obtained from questionnaire survey which was distributed to the construction actors, and also field observation in store project construction in Surabaya. The outputs of the research showed that: (1) waste material volume for the brick (12.51%) and the sand (11.39%) became the highest values, (2) cost model showed that the minimum value of the waste cost (good waste management practice) was 3.33%, and the maximum value of the waste cost (poor waste

management practice) was 4.67% Surabaya. This research was conducted by distributing the form the total cost of the store unit cost, so the potential waste saving cost became 1.34%.

(Rani 2017) conducted analysis and evaluation of the waste material in store project construction in Malang. The outputs of the research showed that the highest quantity percentage of the waste materials were the brick (14.70%) and sand (8.20%). The most affecting causing factors were material procurement, residual, and field construction. Based on the waste material category, the percentage of the direct waste was (average) 72.52% and for the indirect waste (average) 27.48%. The average potential waste saving cost was 3.084% which was Rp 10,656,050.00.

Ghoddousi, and Hosseini (2012) also conducted the research that aimed to evaluate the causing factors, quantity, the effect and follow up of the waste materials in the housing project. The outputs showed that the quality, purchasing regulation and quantity became the most dominant factors related to the material management. While the work experience, commitment and loyalty became the factors causing waste material and worker's behavior. The efforts that should be taken according to the respondents were that the material should be kept for the next project or be discarded. The average of the respondents answered that the waste material quantity was 5% based on the case study.

CHAPTER THREE

RESEARCH METHODOLOGY

3.1 Introduction

This chapter discussed the research methodology adopted for the study. The chapter outlined the research design, the population of the study, sample and sampling techniques, the methods of data collection, the instrument used to collect the data, validity and reliability of the data collection instrument, the ethical considerations as well as the type of data analysis.

3.2 Research Design

Polit & Hungler (1993) revealed that, "survey obtains information from a sample of people by means of self-report, that is, the people respond to a series of questions posed by the investigator". In order to satisfy the objectives of the dissertation, the study adopted the mixed method survey design approach since the researcher is interested in describing and providing quantitative view of the situation or case under study and answering questions under waste management within various real estate firms situated in Accra. A mixed method survey was adopted because it provides an accurate portrayal or account of the characteristics qualitatively and backed by quantitative analysis.

3.3 Population of the Study

A population is a complete set of elements (persons or objects) that possess some common characteristic defined by the sampling criteria established. The study considered the total population of all real estate developers in Greater Accra. These estate firms might be foreign or local firms operating in Ghana. According to the 2010 population census, the greater Accra

region happened to be the second region with the highest share of the total population of the nation. This represented 16.3% of the entire Ghanaian population. Even though it happened to be the second populated region, it was the first urbanizing region with a proportion of urban population of 90.5% (Ghana Statistical Service, 2010).

Considering the fast urbanization rate of the city, demand for housing has also been on the increase making it a hotcake for real estate developers giving the motivation to carry out the study in the capital city rather than any other regional capital.

3.4 Sample and Sampling Size

A sample is defined as a group of subjects selected from a larger group and including less than all the subjects in that larger group, Kothari (2015). Sampling serves to provide practical ways of ensuring that data collection and processing aspects of research are done whilst making sure that the sample is a true reflection of the population (Fowler Jr, 2013). Alam et al., (2015) defines sample survey as the selection of members from a targeted population to be in a sample for a sample. Purposive sampling techniques was adopted by the researcher for the study. According to this method which belongs to the category of non-probability sampling techniques, sample members are selected on the basis of their knowledge, relationships and expertise regarding a research subject (Freedman et al 2007). The study adopted this method since members interviewed were based on the knowledge of and opinion in the subject areas to enables the researcher answer the research objectives.

According to Passer (2004), a sample frame represents the ‘operational definition of the population’. The sample frame must represent the population (Taherdoost 2016). Molenberghs (2010) describes a sample frame as the set of units (individuals) that has non-

zero probability of being selected. In determining the size of a sample in a given population, it is appropriate to use a statistical formula. However, there is no single formula to calculate the size of a population. The two basic factors from the perspective of the statistician is that the larger the sample size the more accurate it can describe a population. The population of the study was 43 (only estate developing firms) in Accra. This 43 firms were found from GREDA as the number of developers under their registration in Accra. The Yamane's formula is used to determine the sample size since the population size is known (Ernest, 2012).

The formula is $n = \frac{N}{1+Ne^2}$

Where n = Sample size

N = Population of study

e = Limit of tolerance error (using 10%)

1 = Theoretical constant

(Yamane, 1973).

In assigning values to these the sample size was calculated as follows

$\frac{N}{1+Ne^2} = \frac{43}{1+43(0.1)^2} = 30.06 \approx 30$ firms

A sample size of 30 was determined and all administered questionnaires were retrieved.

3.5 Methods of Data Collection

The research employed both primary and secondary information sources to answer the research objectives. For the purposes of this research, self-administered questionnaire was used. Both close–ended and open–ended questionnaire were administered which provided participant's emotions, feelings, and opinions regarding a particular research subject and

quantitative representation of coded questions. Also available secondary data with regards to statistics on various waste models practice by institutions was collected and analysed.

3.6 Data Collection Instrument

Questionnaires were used as data collection instrument to determine the best waste management practices among the various estate firms and to management practices employed. Closed ended questionnaires were used to give relevant and concise response for easy analysis. Opened ended questionnaires were also use to give respondents ample freedom to express themselves at length and for their views and opinions to be solicited. Finally, interview guide was also used to help the researcher make follow up interviews through phone calls.

3.7 Validity and Reliability of Data Collection Instrument

Here the Cronbach's Alpha analysis is used to test the validity and reliability of the instrument in each objective area. The Cronbach Alpha was developed by Lee Cronbach in 1951, which measures reliability or internal consistency. "Reliability" is how well a test measures what it should. Cronbach alpha test to see if multiple questions (Likert Scale) survey are reliable. According to Mohson and Dennick (2011), this is grounded in a model called 'tau equivalent model' which assumes that each test measures the same item latent trait on the same scale been used. This gives a unique type of correlation coefficient that estimates the reliability of the survey instrument using the actual response data (i.e., the proportion of variance that is systematic or consistent in the set of test scores (Brown, 1997). The alpha value ranges from 00.0 (if no variance is consistent) to 1.0(if all variance is consistent). Below is the formula for Cronbach alpha; $\boldsymbol{\alpha = N.\ \bar{c} / \bar{v} + (N-1).\ \bar{c}}$

Where:

N = the number of items

$\bar{c}$ = average covariance between item- pairs.

$\bar{v}$ = average variance

A rule of thumb for interpreting alpha for dichotomous questions according to Mohson and Dennick (2011), is as follows;

Interpretation	Excellent	Good	Acceptable	Questionable	Poor	Unacceptable
Scale	$\alpha \geq 0.9$	$\alpha \geq 0.8$	$\alpha \geq 0.7$	$\alpha \geq 0.6$	$\alpha \geq 0.5$	$\alpha \leq 0.5$

3.8 Ethical Consideration

The privacy of every participant in this study is of utmost interest to the researcher and hence the informed consent of respondents or participants are sought and the purpose of the study explained to them for their understanding and thus gaining their support. However, in as much as the researcher solicited for their participation, they are made to understand that, their participation is purely on voluntary basis and that they could withdraw at any point in time of the study. Respondents would equally be assured of a high level of confidentiality with respect to all information given out by answering the questionnaire. A written letter was served to the institutions of interest prior to the questionnaire administration.

3.9 Method of Data Analysis

Data was gathered from administered questionnaires which was sorted and coded before analysis. The surveys were then examined for correctness and completeness of questionnaires. Pre-coded questionnaire data were grouped in accordance to research objectives and then

processed using Microsoft Spread Sheets and the Statistical Package for Social Sciences (SPSS) used for the analysis. The data analysed is presented in tables, frequency distributions and other pictorial presentations to aid the researcher on easy interpretation. Demographic characteristics where analysed using Descriptive Statistical tools whereas further analysis made used of mean score to analyse Likert scale questions posed in the questionnaire. Also, qualitative responses were analysed by coding and ranking and percentages were calculating.

CHAPTER FOUR

PRESENTATION OF RESULTS

4.1 Overview

This chapter presents the result from data gathered from the field using a research questionnaire as a data collection instrument. Basically the relevance of every research work is how effectively the data gathered could be analyzed and presented for easy inference. This is due the fact that proper analysis and presentation leads to effective findings and recommendations, as every research work aims at finding solution to problems.

4.2 Demographic Characteristics of Respondents

4.2.1 Educational Status of Respondents

The educational status of respondents is presented in Table (4.1) below.

Table 4.1: Educational Status of Respondent

Level of education	**Frequency**	**Percentage**	**Cumulative frequency**
Diploma	14	46.7	46.7
Degree	11	36.7	83.3
Master	3	10	93.3
Others	2	6.6	100
Total	30	100	

Source: field survey, 2019

Table 4.1 above indicates respondent's educational status. the table shows that, most of the respondents from the study were diploma holders which represented about 46.7% of the study population, followed by respondents with first degree representing 36.7% of the study population, also about 10.0% the respondents were said to possess a Master degree with only 2% having other qualifications other than master, first degree or diploma degrees. This minority were those with either a professional qualifications or a PhD.

4.2.2 Functional Role of Respondents

Respondents were task to provide their functional role at their various offices and departments. the Table 4.2 gives details of respondents functional roles.

Table 4.2: Functional Roles of Respondents

Functional role	Frequency	Percentage	Cumulative frequency
Project manager	12	40.0	40.0
Engineer	6	20.0	60.0
Architect	3	10.0	70.0
Quantity surveyor	2	6.7	76.7
Others	7	23.3	100
Total	30	100	

Source: field survey, 2019

Table 4.2, above display the functional roles of respondents in their various offices. It shows that, about 6.7% of the respondents were Quantity surveyors, whereas Project managers and Engineers were 40% and 20% of the study population respectively. Also 10% of the study

population were Architects with 23.3% representing other professionals other than the aforementioned.

4.2.3 Work Experience of Respondents

The experience of respondents was measured considering the number of years they have served at their various positions. Table 4.3 present the result of respondent's experience from the field survey

Table 4.3: Work Experience of Respondents

Respondents experience in years	Frequency	Percentage	Cumulative percentage
1-3years	10	33.3	33.3
4-6years	10	33.3	66.7
7-10years	7	23.3	90.0
Above 10years	3	10.0	100
Total	30	100	

Source: field survey, 2019

Table 4.3 above shows respondent's years of experience at their various positions at work. It is palpable that, most of the respondents have worked at their various roles for more than 4 years. About 33.3% of the respondents had a working experience between 1-3 years, with 10% having over 10years working experience. Also 33.3% were said to have about 4-6years of experience at their various positions and respondents who have worked for 7-10years represented some 23.3% of the study population.

4.2.4 Type of Real Estate Firm of Respondents

Respondents were asked to state the category of real estate firms they work with, indicating whether their firms were small, medium or large. The Table below present the result of analysis.

Table 4.4: Type (size) of Real Estate Firm of Respondents

Type of real estate firm	Frequency	Percentage	Cumulative Freq.
Small	5	16.7	16.7
Medium	17	56.7	73.4
Large	8	26.7	100
Total	30	100	

Source: field survey, 2019

From Table 4.4 above, about 16.7% of the respondents indicated that, the size of their real estate firms was small, with some 26.7% of the study population belonging to medium size real estate firms. Majority of respondents were working with real estate firms described as large firms which represented 56.7% of the study population.

4.2.5 Structure of Ownership of Real Estate Firm

The study population included both local and foreign real estate firms working in Ghana, the Table below present the result of respondent's firm's structure of ownership.

Table 4.5: Structure of Ownership of Real Estate Firm

Ownership structure	Frequency	Percentage	Cumulative freq.
Foreign	4	13.3	13.3
Local	26	86.7	100
Total	30	100	

Source: field survey, 2019

Result from the Table above indicates the dominant of local companies among the sampled real estate firms for the study, about 86.7% of the respondents were working with locally owned real estate firm whereas the remaining 13.3% reported to have been working for foreign owned real estate firms in Ghana.

4.2.6 Years of Experience (Existence) of Real Estate Firms

Experience of a real estate firm is very important in measuring their management credentials in any field of study. Respondents were asked to state the experience level of their firms in relation to the number of years such firms have existed. The Table below present the result of respondent's firms' level of experience in the number of years such firms have existed.

Table 4.6: Level of Existence of Firms

Experience of firm(years)	Frequency	Percentage	Cumulative
0-5	8	26.7	26.7
6-10	12	40.0	66.7
11-15	3	10.0	76.7
16-20	3	10.0	86.7
21 and above	4	13.3	100
Total	30	100	

Source: field survey, 2019

The above Table illustrate the experience level of sampled real estate firms in terms of the number of years they have existed. 10% of the respondents stated their firms has been in existence within 11 to 15 years, with 13.3% of the respondents stating that, their firm has been operating for about 21 years and beyond. Another 10% of respondents said their firm is in existence within the last 16 to 20 years now, also some 26.7% of the respondents revealed their firms were in existence within 0 to 5 years, majority of the respondents indicated their firms existed within 6 to 10 years representing 40% of the study population.

4.3 Further Analysis

The study set out to investigate waste management practices among real estate firms in Ghana, specifically, the study had two research objectives, first and foremost the study was to assess the significant waste management practice in the real estate firms, secondly, the study also sought to examine the problems and challenges inherent in the waste management practices.

Objective 1: To assess the significant waste management practices adopted by real estate firms

4.3.1 Significant Waste Management Practices Adopted by Real Estate Firms

From the analysis of waste management practices adopted by the real estate firms in Ghana, Accra to be precise, it can be realized that Re-use of waste management practice has been embraced by most firms. This represent 28% as among others. This percentage of respondents opined that, the re-use system is quite effective and saves or help reduces cost of building materials. They stated that management is aware of implications of waste to the cash flow of the firm and will always appreciate the practice of the Re-use system for cost effectiveness. They further stated that the volume of waste on site is always a worrying thing and this is what

motivate them to Re-use waste generated on site in other not to increase construction waste volumes on site. According to the respondents, one major disadvantage of this system is time consumption and delays as it impedes other activities and could also turns out to give negative cost implications. It is quite clear that findings from literature for instance Agyekum et al., 2012) has it that, the cost of avoidable waste is sometimes higher than the prevention. This is a finding that has also confirm (Al-Hajj and Hamani, 2011) that time and process waste is generated from activities that take time, resources or space without adding value. The time spent in sorting and re-selecting salient and reusable materials to be used for next projects. The awareness of this practice has been good in the industry since majority of the firms practices it for almost 15 years in firms.

The second waste management practice well embraced by the real estate firms happened to be the Recycling of waste. However, they believe that Recycling of waste reduces the expenditure on disposal and the material quantity to be bought as well as the overall cost of the buildings. This finding also confirmed the Scotland (1999) statement that recycling and reclaiming of waste helps reduces the entire cost of a building by 40%. They attest that at a point the cost of disposal of volumes of waste is expensive more than the recycling of such waste motivating them to keep to this practice. This represents 24% of the various waste management practices adopted by most real estate firms in Ghana. They however lamented that this practices equally demands more time and hands as various material need to be carefully selected and segregated for materials to recycle. The predominant disadvantage of most estate firm's opinion was prevalence of contaminants such as lead paints and others. Also this statement is in agreement with (Begum et al. 2006; Chen et al., 2002; Teo and Loosemore, 2001) with the view that construction waste is hazardous to the environment.

Similarly, Papargyropoulou et al. (2011) and Fishbein (1998) among others argued the hostile environmental impact of construction waste. This practices like the waste Re-use system has also been in the system for long since many estate firms believed to have practiced for about 5 to 10 years in operations.

Another well-known waste management practice adopted by many firms is "Disposal of waste". This has been the predominant practices among Ghanaian institutions however, the real estate industry seems to undermine it for so many reasons. The estate firms are not charitable organization and always mindful of the cost implications of wastage of materials on site. This made up of 21% representation among the other practices. This indicates a deviation from the day by day waste creation to the adoption of most effective methods in the treatment of waste among estate firms. The respondents reason or motivations were for the fact that disposal is less expensive and doesn't consume time. To add to these reasons, they stated that though it is easy, less expensive etc., it does not encourage innovations in the industry and making them cling to the old practices or system of operations. Confirming this in literature, Yaun (2013) categorically stated that, "the implementation of technologies such as innovations in construction project will contribute to the generation of construction waste". This people believe that lack of technological advancement and innovations has enable them keep to the old practice of waste management. Another finding from (Polat and Ballard, 2004; Formoso et al., 1999; Womack and Jones, 1996) indicated that, the level of unavoidable waste is dependent on technology. One motivating reason of this practices is lack of space for waste to be kept before recycling or re-use making management tend to opt for disposal.

Waste minimization or Reducing waste generation has still not been embraced by estate firms in Ghana. This represents only 3% of the total waste practices adopted by the firms. Most

estate firms tend to combine this practices with Re-use system of waste management representing 10% of the various practices. These people hold the view that fabrications are made from those waste that are used for different projects. They are much aware of technicalities that need to be in place to reduce waste generation but in the quest to speed up work, human errors and other haste activities causes more waste.

The remaining waste practices opined by others were the combination of any of the various waste management system due to cost, volume of waste, waste type and sources of waste. They try to opt for disposal when waste is small in volume or recycle when waste source can make separation easy for recycling.

4.3.2 Determining the significant waste management practices in the real estate industry.

Table 4.7: Mean Score Ranking of Practices

Waste management practices	Mean Scores	Rank
Waste Re-use	4.38	1st
Waste recycling	4.22	2nd
Waste minimization	3.89	3rd
Disposal	3.12	4th

Source: field survey, 2019

Managing and monitoring different waste streams on a construction site requires careful planning. Understanding how wastes occur in the first place will help prevent and manage waste more cost-effectively. Waste streams vary according to the phase of construction, the

method and the type of building making it important to adapt waste management practices to suit the specific site and phase of construction.

The first research objective was to assess the significant waste management practices adopted by real estate firms and to achieve the aim, the researcher employed mean score to identify respondent's expert opinion on significant waste management practices adopted by real estate firms. Table 4.7 above shows that respondents rated waste re-use as the significant waste management practice by their expert opinion with a mean score of 4.38, followed by waste recycling with a mean score of 4.22. The third (3rd) significant waste management practices/approach is said to be waste minimization practice with a mean score of 3.89 and the least significant waste management practices were said to be waste disposal method with 3.12 of mean score.

The findings of the study however are in contradiction with the available literature. According Mark et. al. (2016) the significant waste management practices is said to be waste minimization, followed by waste re-use practice. The third significant waste management according to literature is recycling and at the bottom is waste disposal as least significant waste management practice. Also the findings confirm Scotland (1999) which stated that, the reclaiming and recycling of materials serve as the best. It stated that these methods can save 70% embodied energy and thereby reducing the entire building price by 40%.

Objective 2: To examine the problems and challenges inherent in the waste management practices

4.3.3 Problems and challenges inherent in the waste management practices.

The last research objective seeks to investigate the challenges and problems of waste management facing the real estate firms.

The analysis revealed that, majority of the respondents agree that high cost of waste management is a leading challenge in construction waste management representing 60% of the sampled population, another 33.3% of the respondents indicated that, they strongly agree the assertion, with only 3.3% stating that, they strongly disagree with the assertion that, high cost of waste management contribute to the challenges in construction waste management in the construction industry in Ghana. A small fraction of the respondents representing 3.3% revealed that, they are neutral on the assertion that high cost of waste management is a challenge on waste management practices in the real estate industry.

On the issue of whether or not inadequate skilled labor on waste management is a challenge facing the real estate industry, about 60% of the respondents agree to the assertion with 23.3% stating they strongly agree. Another 10% indicated they disagree and 6.7% strongly disagree. It's obvious that, generally respondents affirm the fact inadequate skilled labor for waste management remains a serious challenge in waste management in the real estate industry. This results are in line with Poon et al., (2001) and (Nagapan et al., 2012; Yuan, 2013; SWCorp Malaysia. 2015.) as they opined that, waste reduction and waste management culture from design stage to the main workers on ground contribute to volume of waste produce on site.

Project manager's commitment to waste management practices is said to be a challenge to proper waste management practices in the real estate firms in Ghana, respondents were very

emphatic on their level of agreement. About 53.3% agree and 16.7% strongly agree that, lack of commitment on the part of project managers contribute to the challenges of waste management practice among real estate firms in Ghana. Some 10% of the respondents took a neutral stance, with 13.3% and 6.7% stated they disagree and strongly disagree respectively. The overall impression created by respondent's shows that they generally affirm that the level of commitment by project managers on waste management is an ongoing challenge in the real estate industry.

The environmental protection agency is mandated by law to supervise every activity that is detrimental to the environment and whatever is found in it. Respondents were asked whether the shrieks of this responsibility could lead to challenges of waste management in the real estate industry. From the table above, about 66.7% stated they agree, and another 30% said they strongly agree with only 3.3% disagreeing to the assertion. Generally, from analysis, it can be concluded that, respondents seem to affirm the challenges that comes with poor or inadequate supervision of the EPA that results into none compliance from the part of industry players and hence leads to real challenges in waste management. Literature from Puopiel (2010) confirms the low performance by EPA and as such the results. He further stated that, lack of guidelines from EPA has also contributed enormously to the poor waste management in our institutions.

According to Mark (2015) on site waste reduction is one of the best waste management practices that can lead zero waste generation in the construction industry respondent were asked to give their expert opinion on the subject relating poor attitude of construction workers to reducing waste, about 73.3% forming majority revealed that they agree, and 16.7% stating they strongly agree. Strongly disagree, disagree and neutral all recorded 3.3% each of them.

Table 4.8: Mean score ranking of challenges and problems in the waste management

Waste management challenges	Means Scores	Rank
High cost of waste management	4.89	1st
Inadequate skilled labor on waste management	4.35	2nd
Poor attitude of construction workers to reduce waste on site	4.18	3rd
Poor supervision by EPA	3.87	4th
Lack of commitment on the part of project managers	3.05	5th

Source: field survey, 2019

The mean Score was used to rank the individual challenges confronting the real estate industry in other to establish which of the challenges happened to be the most severe. The result shows that, high cost of waste management seems to be the most severe ranked at the first position with a mean score of 4.89, this was followed by inadequate skilled labor on waste management with a mean score of 4.35. Poor attitude of construction workers to reduce waste on site was placed 3rd with a mean score of 4.18 and poor supervision by EPA placed 4th with a mean score of 3.87 and the last most severe was the lack of commitment on the part of project managers to waste management which recorded a mean score of 3.05.

CHAPTER FIVE

SUMMARY OF KEY FINDINGS, CONCLUSIONS AND RECOMMENDATIONS

5.1 Overview

This chapter discusses findings from the analysis of the data gathered from the field survey, conclusions drawn from the study as well as appropriate suggestions of recommendations to guide estate firms, contractors and construction firms and other stakeholders in construction waste management. The objectives of this study was to assess the significant waste management practices adopted by real estate firms and to examine the problems and challenges inherent in the waste management practices.

5.2 Summary of Key Findings

This study had the aim of assessing waste management practices of real estate firms in the greater Accra region. This study is deemed relevant us it will inform construction and real estate industry players to be mindful of consequences of construction waste and its benefits when carefully managed. Table 4.7 of the analysis revealed that, Waste Re-use is the significant waste management practice among real estate developer. This had been ranked 1st with a mean score of 4.38. This per the expert's opinion indicate how cost mindful the estate developers are when using building materials. The least ranked practice happened to be Waste Disposal indicating low tolerance of it with a mean score of 3.12. The analysis revealed that disposal as a type of waste management does not promote innovation in the industry.

Qualitative analysis revealed that the most adopted waste management practice by most real estate developers is Waste Re-use of the 28% of respondents. Majority of the developers embraces re-use of waste in their practices. This finding is in consonance with (Poon et al.

2001; Hao et al. 2008; SWcorp Malaysia, 2015) as it indicates that on site waste sorting could increase the rate of reuse and recycling and directly reduce the logistic cost and dumping cost. Estate developers tend to do barter trade of waste to other estate firms who are in need at a particular stage in the development cycle to avoid dumping and disposal cost.

Lastly the major challenges faced in waste management practice is inability of EPA to fully discharge their supervisory role to ensure that certain principles are adhered to in waste management and to provide waste management policy. This confirms the Samuel et al. (2015) that the ever increasing number of generated construction waste is as a result of no adequate enforcement measures put in place by regulatory authorities. About 66.7% of the respondents believe that absences of their role is challenge. This was followed by high cost of waste management and inadequate skilled labor on waste management which attained 60% endorsement from the respondents leaving lack of commitment on the part of project management to be last with 53.3% of agreement level by respondents. Generally, all these findings confirm the findings of (Nagapan et al. 2012; Yuan, 2013; SWCorp Malaysia 2015.) as major factor influencing construction waste management.

5.3 Conclusion

The purpose of the study was to assess the waste management practice of real estate firms. From the findings and analysis of data, it can be concluded that waste management practice is well embraced by real estate developers. However, the inability of EPA to fully discharge their supervisory role to ensure that certain principles are adhered to in waste management and to provide waste management policy is a major blow to the best realisation of waste management. It can also be concluded that, waste disposal method has been frown on

however, lack of enforcement from regulatory agencies still provide a room for its existence in the industry. The sector has also taken waste management to different level to the extent of barter trading of waste among estate firms.

5.4 Recommendations for the Study

1. The researcher recommends that, estate developers diversify waste management practices in other to explore other benefits regarding the volume of waste and type of waste produced and the cost implications.
2. It is recommended that the EPA provides a Waste Management Plan or policy and to monitor to ensure that construction industry players adhered to best practices.
3. It is strongly recommended that contractors and estate developers get market players to market waste products thank barter trading since large volume of waste cannot be barter traded entirely.
4. It is also recommended that further studies should gear towards waste management type and financial implications to the firms.

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APPENDIX

KWAME NKRUMAH UNIVERSITY OF SCIENCE AND TECHNOLOGY (KNUST)

RESEARCH DATA INSTRUMENT

WASTE MANAGEMENT PRACTICES OF REAL ESTATE FIRMS

Dear Respondent

This Data Instrument forms part of a Master's thesis research at the Kwame Nkrumah University of Science and Technology. The series of statements below are designed to study the Waste Management Practices of Real Estate firms (the case of real estate firms in Accra). You are kindly requested to indicate your opinion by answering the questions provided with sincerity and honesty. If your option does not match exactly with any one of the options provided, please choose the one that is closest to your considered judgment, and best fits or describes the actual situation that prevails in the institution.

This exercise is purely for academic purposes and all information provided will be treated in the strictest confidence. You have the freedom or right to withdraw your participation at any time. If you have any questions about the research, please call Mr. Abdulai Wumbei (0547983184).

Thank you very much for your co-operation.

SECTION A
(**Background Information**)

This section seeks to explore respondent's demographic characteristics.

1. What is your education level? Diploma level [ ] Degree level [ ] Master level. [ ] PhD level [ ] others (specify)……
2. What is your function role? Project manager [ ] Engineer [ ] Architect [ ] Quantity surveyor [ ] other (please specify) …….
3. Please state your working experience. 1- 3years [ ] 3- 6 years [ ] 6- 10 years [ ] 10 years and above [ ]
4. Type of real estate firm. Medium [ ], Large [ ], Small [ ]
5. structure of ownership: Foreign [ ], Local [ ]
6. Years of company existence: 0 to 5 [ ], 6 to 10 [ ], 11 to 15 [ ], 16 to 20 [ ], 21+ [ ]

SECTION B
<u>Ascertaining best waste management practice in the real estate sector</u>

7. Rank the following waste management practices on the scale of excellent to extremely poor.

Items	**Ranking: Excellent=1, Very good= 2, Good= 3, Average=4, Poor = 5, Extremely poor=6**
Minimizing or Reducing waste generation	
Re-use of waste generated	
Recycling of waste generated	
Disposal	

SECTION C

Identify the various waste management practices adopted by real estate firms

This section seeks to identify the various waste management practice used by the sampled real estate firms in the greater Accra region.

8. Kindly indicate the waste management practice that has been adopted by your firm

……

……

9. What motivate the choice of the above mentioned method by your firm?

……

……

10. How long have you practiced the above mentioned waste management method at your firm……?

……

11. Kindly stated advantages and disadvantages of the used method in your firm.

i. Advantages…….

…….

…….

……

ii. Disadvantages……

…….

……..

……

SECTION D

Identify the problems and challenges inherent in the waste management practices

This section seeks to identify the problems and challenges confronting the real estate industry on waste management.

12. High cost of waste management is a deterring factor on waste management practices among real estate firms. **A) Strongly disagree [ ] B) Disagree [ ] C) Neutral [ ] D) Agree [ ] E) Strongly agree [ ]**
13. Inadequate skilled labor on waste management is one of the challenges facing real estate firms. **A) Strongly disagree [ ] B) Disagree [ ] C) Neutral [ ] D) Agree [ ] E) Strongly agree [ ]**
14. Lack of commitment on the part of project managers is a problem on waste management practice by real estate firms. **A) Strongly disagree [ ] B) Disagree [ ] C) Neutral [ ] D) Agree [ ] E) Strongly agree [ ]**
15. Poor supervision by Environmental Protection Agency is a challenge on waste management practice by real estate firms. **A) Strongly disagree [ ] B) Disagree [ ] C) Neutral [ ] D) Agree [ ] E) Strongly agree [ ]**
16. Poor attitude of construction workers to reducing waste at construction site is a problem on waste management in the real estate industry. **A) Strongly disagree [ ] B) Disagree [ ] C) Neutral [ ] D) Agree [ ] E) Strongly agree [ ]**