Challenges of Encouraging Waste Reduction in Commercial Project within the Ghanaian Construction Industry

Abstract

The rapid growth in population and the significant work of construction in many countries is causing challenges related to the management of construction waste. Similarly, the challenges associated with waste management practices have also impacted the construction industry of Ghana. Therefore, the main focus of this study is to analyse the challenges that encourage activities of waste reduction in the commercial projects of the construction industry in Ghana. The study recognises the research problem which mentions that the construction industry in Ghana is subjected to major problems associated with the disposal of waste materials such as cement, brick, tiles, ceramic, and concrete. Furthermore, the study used primary data collection methods to acquire qualitative data through interviews from a sample size of 30 participants which included experts in the industry, managerial employees, project managers and contractors in Ghana, and on-site workers working on construction projects. Moreover, the study used thematic analysis to analyse the findings and data of the research area. Therefore, the findings suggest that the role of workers and project managers is crucial in waste management activities. Furthermore, the challenges of cost and affordability are responsible for the lack of effective waste management practices in the Ghanaian construction sector.

TABLE OF CONTENTS

Chapter 1: Introduction

1.1 Introduction

The world faces one common challenge, which is waste disposal of construction projects (conserve-energy-future.com, 2020). As the population of human increases, arises the need to create living space for them which implies construction of new roads, houses and commercial buildings. Due to this steady growth in population and the consequential construction works, many countries are facing challenges on how to manage their construction waste. Thus, local authorities as well as governments are being overwhelmed by it (Douti, Abanyie and Ampofo, 2017). Adu-Boahen *et al.* (2014) write in their paper that noticeable waste disposal problems can be seen in 9 out of 10 African countries and a visit to Ghana's town and cities depicts a severe problem in waste disposal management. This is evidenced at the sight of heaps of rubbish, scattering of polythene bags, overflowing or overloading of sites with construction wastes which consequently results in health risks such as malaria, cholera and typhoid to the people who have proximity to the waste disposal sites.

To assess the waste reduction challenges in the construction industry of Ghana, the research has focused on the waste management of solid materials like concrete, bricks, tiles, cement and ceramics.

1.2 Contextual Background

The construction industry of Ghana is the basic pillar for the development of the city and accounts for 14.8% of Ghana's annual GDP (Adu-Boahen, 2014). The construction industry of Ghana recorded a postive increase of 16.8% in the year of 2016 and continues to grow (Veitch, 2017). As the population increases, there is an increasing demand for the housing and private enterprises construction, the Ghanaian industries are working on the greater scale to provide the citizens with their basic need and this calls for a surge in construction which

leads to an increase in the waste disposal from the industries affecting the environment and the citizens (Marzouk and Azab, 2014). The cities in Ghana are under bigger concern for the waste management issue than the small towns (Amoah and Kosoe, 2014). Some of the waste is transported to the legal dump areas whereas majority of the waste is left to defuse in the environment (Njoroge, Kimani and Ndunge, 2014). Waste should be dumped according to its type to the respective dumping areas, burned, or recycled (Moh and Manaf, 2014). The current situation of the country depicts that much have to be done to overcome the waste management challenges.

1.3 Research Aim and Objectives

The aim of this study is to explore the challenges in encouraging waste reduction activities within the commercial projects of the Ghanaian construction industry. The objectives of the research are given as follows:

- To determine the role of commercial construction projects in Ghana in producing waste and measures put in place to curb it and to provide recommendations for waste reduction in commercial project within the Ghanaian construction industry.
- To evaluate the role of construction workers and project managers in implementing waste reduction practices for commercial construction projects.
- To identify the challenges being encountered in waste reduction in commercial project within the Ghanaian construction industry

1.4 Research Problem

The factors considered from the literature suggests that the Ghanaian construction industry is facing a major problem of waste disposal with materials like cement, bricks, tiles, ceramic and concrete thus several measures should be taken to reduce the waste disposal.

Previous research undertaken reveals the direct pressure exerted on the construction industry as the Ghanaian population increases (Cobbinah, Gaisie and Owusu-Amponsah, 2015; Ametepey, Aigbavboa and Ansah, 2015). There is an upsurge in the construction activities and therefore the waste disposal increases which eventually leads to a major problem (Heacock *et al.* 2015). It has been considered that the problem arises with the employees as well since they are not fully trained and are oblivious to waste disposal programmes (Ofstad *et al.* 2017). This gaps can be addressed by providing the employees with a training programme about recycling procedures (Kheni, 2014). An analysis shows that the government is working on the waste disposal policies and procedures and constructing an infrastructure for waste dumping (Oteng-Ababio, Amankwaa and Chama, 2014). There is a greater need for creating waste management policies and programmes (Manahan, 2017).

1.5 Rationale of the Study

Methane production from construction waste significantly impacts the environment on a continuous basis, as it is a greenhouse gas and causes global warming (Marrero et al., 2017). Having multiple efforts by the governments across the globe, the issue is still unresolved and not even technology is effectually able to curb it (Adu-Boahen, 2014). Therefore, the rationale of this study is to find out challenges which Ghanaian construction is facing, regarding waste reduction, so that the overall ecological impact of this sector can be reduced. Such issues of waste management have to be addressed in order to find out the solutions so that implementations can be enacted.

1.6 Significance of the Study

This study encompasses the challenges faced by the Ghanaian construction industry regarding waste disposal and the measures taken to overcome the problem. It is not only the

duty of government or factory labourers to work on minimizing waste disposal issue but it is also the duty of the citizens to co-operate (Budica *et al.* 2015). In accordance to overcome the problem that is affecting the whole country, it is the duty of every single person to play a role in solving the issue and follow government policies.

1.7 Structure of the Study

The structure of this study includes the following sections;

Chapter Introduction: In this section, general overview of the topic is given and discussion is made on the background of the topic.

Chapter Literature Review: In this section, the research focuses on past studies that show the waste management problems in Ghana. Arguments from different researchers will be gathered and from the perspective of the construction industry will be explained.

Chapter Research methodology: This sections aims to describe whether the methods employed in this study is qualitative or quantitative.

Chapter Data collection: In this chapter, data will be collected in order to produce results that would enable the researcher to support their objectives.

Chapter Data Analysis: After the collection of data, data will be analysed in this chapter to produce results, so that the objectives are achieved.

Conclusion and Recommendations: In this last section, the research will give their final comments on what were the results obtained from analysis. Recommendation will also be provided should there be any case of flaw in the system or management.

Chapter 2: Literature Review

2.1. Conceptualising Waste Production

Waste is considered as the by-product of human activities, commonly known as *'Useless Remains'* generated from use (Corwin, 2018). According to this definition, waste production in construction is the act of buying, using and finally discarding a product. Although, waste is not only generated from human use, it can also be a product of construction processes. White, Dranke and Hindle (2012) have described waste generation in an industry like the construction industry in four interlinked steps. According to the study, a factory consumes materials and energy to develop a good or service of value to its customers. However, in the process of creating that product of value, several unused or discarded items are thrown away as waste. This entire process is called waste production

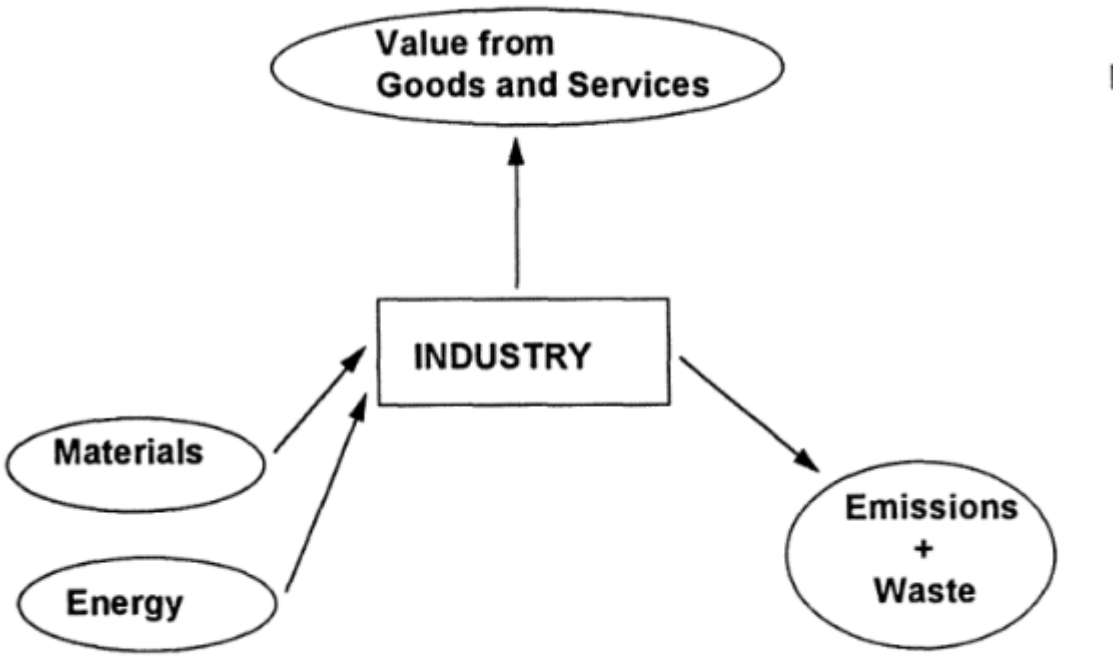

Figure 1: Waste Production in Industries (Dranke and Hindle, 2012)

The concept of waste production is associated as a high risk phenomenon to the environment and even human health (Corwin, 2018). This is because of the vast number of

waste generated on a daily basis, globally. According to the United Nations Environmental Program (UNEP) (2020), estimated 11.2 billion tonnes of waste is generated every single day, containing organic, electronic, and even hazardous waste. Most of this waste, including discarded construction material is dumped in landfill sites that contribute 8% in the global greenhouse gas emissions (Farr-Wharton, Foth and Choi, 2013). Furthermore, Haas et al. (2015) adds that only 28% of the total waste gets recycled, which means that 72% of global waste is discarded with no second use. This an enormous figure, which portrays the enormity of the problem of waste production in the world.

2.2. Conceptualising Waste Management

Waste management, particularly solid waste management is the practice of collecting, treating and disposing waste substances in a sustainable way (Encyclopaedia Britannica, 2020). Waste management is a complex task with several steps, which may vary from use of technology to even hand sorting. The purpose of managing waste is to ensure that waste production causes the least amount of environmental damage and proves sustainable for human health (Brunner and Rechberger, 2015). To achieve this purpose, waste management integrates social, environmental and economic aspects of waste production in different sectors. There are several efficient ways in which waste can either be reduced or discarded sustainably. Encyclopaedia Britannica (2020) notes down that waste management can be done by reduce, reuse and recycle, along with composting, fermentation, landfill, incineration etc.

In terms of the industrial sector, a number of applications can make them environmentally friendly, in terms of waste generation and discarding. The study of Ravindra, Kaur and Mor (2015), focused on municipal authorities and suggested a model of improving working conditions to improve waste management. While another study provided suggestions for the construction industry for waste minimisation, in order to decrease the amount of waste

generated and consequently improve waste management (Ajayi et al., 2017). On the other hand, Ajayi et al. (2015) also conducted a study on the construction industry and concluded that obstacles are present in waste reduction. The study showed that changes in the design stage and use of pipe treatment can significantly decrease waste.

2.3. Construction Industry of Ghana

The manufacturing industry contributes to the financial productivity of the country (Gelb, Meyer and Ramachandran, 2014). By providing the population of its country with the basic needs required and enhance their living conditions. The construction industry of Ghana is an example of such a productive industry that aids the country. Ghana has one the fastest growing construction industry, with railway, roads and property projects all over the country (Osei-Kyei and Chan, 2017). The demand for construction industry can be attributed to the growing urban areas of the country and a young population. Ahadzie (2019) further notes that the construction industry makes up almost 14% of the total GDP and government spending shows that the industry will grow much more. The reason for such a robust growth is the country's political stability and economic growth due to industrialization (Osabutey and Croucher, 2018). This has made Ghana an emerging market in the African continent and Ghana's construction industry has a major hand in this growth. Although, it is also important to note that the lack of government policies and contractor incompetency has resulted in massive environmental damage from this sector (Ahadzie, 2019). Therefore, optimal decision-making is required for Ghana's construction industry that can indicate a long term sustainable growth.

2.4. Waste Production in Constriction Industry of Ghana

The major problem faced by the construction industry is waste production (Bilal *et al.* 2016; Huang *et al.* 2018). It has an effect on the working of the industry by the loss of inventory and reduces the time duration of the task to be completed which results in a loss of money. Waste production occurs due to several different practices performed during construction which could be woods, cement, inventory wrappings and other construction waste. All this wastes needs to be transported from the construction area to the legal dump areas for the proper operation of the industry and not causing harm to the environment or the citizens residing close to the industries (Gangolells *et al.* 2014). There are various reasons which contribute to the waste production (Joshi and Ahmed, 2016), some of them are poor infra-structure of the industry which often requires renovation, the labourer's faults during construction, wrong choice of land for the industry's setup, climate changes and no proper setup for the waste disposal. The waste disposed of by the industry gathers at a particular place and creates an unlawful dump which becomes a reason for the health related issues for the citizens and causes damage to the surroundings (Suleman, Darko and Agyemang-Duah, 2015). This happens because of the egotistical decisions of the contractor who does not pay for the suitable waste disposal to the legal dispose area (Hussin, 2013).

Djokoto, Dadzie and Ohemeng-Ababio (2014) further discusses the point of waste production in the construction industry by noting two major resources used by the industry, steel and cement. According the study, for every tonne of cement produced, at least a tonne of Carbon Dioxide is released into the atmosphere, while steel production contributes is an immensely energy-intensive product. Based on these findings, it can be argued that the construction industry not only contributes to waste generation, but also degrades the environment due to the raw products consumed. Aigbavboa, Ohiomah and Zwane (2017) believes that construction is a sink for non-renewable resources and a massive source of waste

that cause air pollution and water pollution, along with irreversible damage to land management. Hence, construction is a major contributor to the pollution levels on a global scale, including Ghana which is high in biodiversity and natural resources.

Furthermore, Ametepey and Ansah (2014) conducted a study on the construction industry of Ghana by conducting surveys with the workers, project managers and other key stake holders. The study identified ten major sources of pollution for Ghana construction industry, consumption of raw material, noise pollution, encroachment activities, interfering with the local flora/fauna, water pollution, electricity consumption, land pollution, particulate matter (PM), solid waste and fossil fuel usage. Among these ten major sources of pollution, mostly are related to solid waste production and their management. Therefore, it is evident that the biggest problem for the construction industry in Ghana is its waste production, in the form of PM or solid waste. It is important to overcome this problem because waste generation in such high amounts in Ghana can result in a massive damage to the environment and biodiversity of the country (Cobbinah, Black and Thwaites, 2015). The study further illustrates that this can affect the economy of the country by influencing livelihoods for the rural population.

2.5. Regional Issues of Construction Industry's Waste Production

The significance of the Ghanaian construction industry cannot be underestimated as it is the most productive industry financially in West Africa (Agyekum, 2012). Ghana is not the only country facing challenges of wastage issues and it is not the only country needing solutions to minimize waste, however there are many countries across the globe which are facing the same issue (Adu-Boahen et al., 2014). Adu-Boahen et al. (2014) says in their study that in Zimbabwe and Zambia, under South Africa is consisting large amount of atrocious wastage bags. Black polythene bags are often considered as 'national flowers' in South Africa because

black polythene bags can be seen everywhere including fences, gutters and drains. These garbage bags are working as a disease of landscape in South Africa (Adu-Boahen et al., 2014). Since, the issue is widespread globally and hence the precautions are needed. More researches could give supplementary solutions to this ever emerging problem in majority regions and countries extensively. Therefore, the current study is targeting the context of Ghana and findings would suggest the best achievable results for the contribution in waste minimisation.

2.6. Role of Construction Workers in Waste Management

Construction site workers and project managers can play a key role in determining green waste reduction practices to be employed on construction sites. However, Poon et al. (2013) notes that workers usually have a negative perception about any changes to their conventional methods of working. Therefore, they are not open to changing their practices, in order to ensure waste management within the construction industry. The study of Zhang, Wu and Shen (2012), has identified workers or labourers on a construction site as barriers to turning construction industry sustainable, as they carry on with uneconomical and environmentally degrading practices. Regardless of the data that indicates severe losses to biodiversity, water and soil cleanliness, due to construction debris and waste. Although, construction workers can play a greater role in ensuring waste reduction by conducting waste sorting practices, reusing material, recycling aggregate and overall avoiding waste production at each stage of building (Poon et al., 2013). This is an effective layout of probable measures that can be taken by contractors, workers and other on-site staff to improve waste management.

In terms of project managers and other stakeholders that invest in construction industry, Yuan (2013) highlights that they can also be critical in ensuring waste management. According to the study, project developers, on-site managers, engineers and even investors can be vocal about green practices on the site of construction. Based on this, if people on higher roles of

executives and managers ensure waste reduction practices then even lower working staff will comply. Furthermore, Ding et al. (2018) has highlighted the role of designers and engineers in applying measures, policies and action plans to reduce overall waste created from construction. According to the research, in the planning phase of construction, designers can take an environmentally friendly approach by providing reduction, reuse and recycling measures throughout the construction process.

Moreover, it is also important to note that most of the workers on construction sites have limited to almost zero knowledge about the issue of waste production from construction projects and their consequent effects on the environment. Yuan (2013) states that project managers usually prioritise time-saving and money-making activities more than waste reduction, therefore staff training on waste management is not a common practice. This adds up to the overall problem, as the lack of knowledge in workers leads to hazardous working conditions, in which products are consumed uneconomically. Therefore, there is a need to train on-site workers, from labour, manager, to contractor and even key stakeholders to prioritise waste management.

2.7. Challenges to Waste Reduction in the Construction Industry of Ghana

According to a study, construction projects on an average waste 9% of the total products that are used (Hussin, Rahman and Memon, 2013). This includes wasting cement, steel, plastic and other materials that can be easily used. This is a relatively high ratio of waste generated and material purchased by weight, as compared to other major sectors like factories. This high ratio is due to several factors that pose severe challenges to reducing waste and adopting green management practices in the construction industry. The issue of cost is a major challenge to reducing waste, as most of the building projects surpass their initial cost and stakeholders avoid added costs of waste management (Hussin, Rahman and Memon, 2013). This is an issue of

priority for project managers and workers because of a consensual mind set of saving costs from all stages of the building process. In terms of cost, Liew, Sojobi and Zhang (2017) adds that affordability is another obstacle for applying waste management in construction industry. Most of the solutions for waste management include technological advancement or hiring a waste contractor, which are both costly measures for contractors. Therefore, due to lack of affordability, construction projects usually do not employ waste management practices. On the other hand, Alwan, Jones and Holgate (2017) believes that cost is not a major issue, rather the underlying culture within the industry of saving cost is the issue. The study argues that waste reduction practices are often considered as an unnecessary expanse, which is not needed for the betterment of their practices. This proves as a massive barrier to sustaining the overall industry and changing the outlook of workers towards waste reduction and management.

Waste management is one of the rising issues in the current era (Adu-Boahen, 2014). According to Douti, Abanyie and Ampofo (2017), one of the major environmental problems regardless of the context in districts and cities across the globe is of waste disposal (Dahlbo *et al.* 2015). There are many previous studies (Miezah *et al.* 2015; Liu *et al.* 2015; Das and Bhattacharyya, 2015) conducted on this issue and their findings suggest that in developing countries much of the solid waste caused is 55%-80% by households, 10%-30% by market areas and the remainder by other institutions (Douti, Abanyie and Ampofo, 2017). The problems in construction include low quality and high costs; it further includes less-productivity and poor co-ordination. According to Ayarkwa, Agyekum and Adinyira (2011), the more high the cost is of the product the more it is of poor quality, less-efficient and more waste-generated. The study further suggests that by reusing the waste materials and by using low wastage technology or by recycling the waste materials could be some of the best measures to practice waste reduction measures in Ghana (Ayarkwa, Agyekum and Adinyira, 2011). According to Douti, Abanyie and Ampofo (2017) the rate of waste formation in Ghana is 0.47

kg /person /day, which could be around 12,710 in a single day, and the current population of Ghana, is 27,043,093. The large amount of generated waste by the residents are scattered on the footpaths and streets, or in streams (Douti, Abanyie and Ampofo , 2017; Owusu-Sekyere, Bagah and Quansah, 2015).

2.8. Solution for Waste Management in the Construction Industry of Ghana

In order to ensure waste management practices in the construction industry, it is important to consider the role of each stakeholder from worker to investor and each phase of building from planning to discard phase. The study of Udawatta et al. (2015), has highlighted that waste reduction must be implemented by being mindful of waste generation. This can be done by ensuring employee awareness and training, so that they are able to identify wastage and uneconomical usage of material. In terms of employees, it is also necessary to create a sense of teamwork and supervision from managers, in order to assure that workers are complying with green practices and avoiding conventional methods that generate waste (Udawatta et al., 2015).

Furthermore, as cultural trends have been identified as the major issue of waste generation in the construction industry, legislation is an effective solution for ensuring acquiescence (Zuo et al., 2015). According to the study, if governments, local, federal or even global administrative bodies like the UN, setup rules and monitoring bodies then the entire construction industry can be forced to become sustainable. In terms of Ghana construction practices, the government has to bring change from the level of policy. Owusu-Sekyere, Bagah and Quansah (2015) further adds that for Ghana collection of waste is the foremost issue because municipal organisations are often corrupt and incompetent. Therefore, the study provides the solution of importing technology of waste collection or hiring an international company on a regional basis for collection of waste. Such a measure will result in competency

of the concerned authority and will increase a sense of accountability. Ametepey et al. (2015) further identifies that political barriers must be removed from waste management in construction industry, which will ensure credibility. Moreover, it is also important that the staff is trained and aware of waste management, so that a cultural shift can be brought from conventional methods to sustainable practices in construction projects.

Furthermore, use of adequate raw materials and using substances or products before they expire, along with using variety of construction equipment are considered by professionals as the best measures that could contribute to waste reduction in Ghana. These measures are the three most practicable measures which are used in Ghana to minimize the wastage (Ayarkwa, Agyekum and Adinyira, 2011). To overcome waste disposal challenges, the industry needs to accomplish some goals and work on some practices including buying enough amount of inventory which could be used before getting expired, use of good quality materials, maintaining a good relationship with the supplier so that no overloaded material is transported, construct proper storage rooms for the storage of raw materials and nothing gets wasted, training employees regarding the use of materials in a rightful manner. Aslo, the employees should be aware of the current technologies used to dispose waste material, workshops should be held on a weekly basis providing the employees with the knowledge of recycling of waste material and appropriate usage of the equipments. These practices would alter the waste disposal activities to a greater extent (Agyekum, 2012).

2.9. Construction related policies in Ghana

The industrial sector is well developed in Ghana and so it is blessed with abundant natural resources to maintain the sustainable use of its resources the Environment Action Plan functions to restore environmental conditions of Ghana. The Environmental Action plan was formulated in 1988 (Environmental Protection Council;Ghana).

Ghana has implemented legislations for the protection of natural environment. Formation of laws began in the 1974 when the Environmental Protection council was formed to discuss ecological concerns in Ghana. An Environment Protection Agency act was approved in the late nineties. The Environmental Protection Agency works in order to restore and impose government laws and legislation to improve environmental conditions in the country which also focuses on the solutions to resolve environmental concerns (Adjarko, Gemadzie and Agyekum 2016).

The Environmental Protection Agency was formed under decree of Environment protection decree. The initiation of the agency was done by Nathaniel Moore. The task of responding to all environmental concerns was designated to this EPA. All the matters on governmental level were to be addressed under this legislation (Yeboah and Mensah 2014).

2.10. Factors affecting construction waste management in Ghana

There is an immense need eliminating waste in order to sustain our environment. This can be achieved by implementing reducing, re-using and recycling practices (Ali, Ali, and Bayyati 2018). Waste imposes a negative effect on economy and environmental conditions. It has been an environmental concern to reduce the construction wastes (Al-Rifai, J.A.R. and Amoudi 2016).

Waste management is the most important concern in ecological point of view. According to a research paper by Jessica McAllister: Ghana focuses on reducing waste by re-using waste. They consider waste itself a resource and even use it earn money while most of the other countries does not follow this practice. Currently Ghana is facing troubles due to mass production of waste from the construction industries which includes plastic production to be the greatest environmental issue that is causing harm to sewage systems and also the local animals that feed upon them. Ghana is taking strict actions to reduce the usage of polythene

shoppers. Another problem faced by Ghana is the reduced number of waste dumping sites, improper dumping of waste causes health and ecological issues (McAllister 2015).

A major factor that affects waste management is the selection of proper dumping site of the waste in order to prevent pollution. According to a survey in Ghana at Oti Landfill site which showed increased amount of plastic waste present in the dumping site and compaction of waste in those sites were being applied (Owusu-Nimo et al., 2019). Implementations of law is also very important factor when managing of waste is being done. A proper law ensures to secure environmental conditions of the area (Barsalou and Picard 2018).

2.11. Factors affecting waste reduction in commercial project

A few factors have great influence on reduction of waste in a commercial project. These include reducing waste, re-using the items again and to recycle. The quantity of waste generation can be reduced by developing strategies to produce lesser amount of waste. Similarly, certain products can be used again to save resources. At last recycling of products is very necessary which can prove to be an option of preventing the garbage dumping sites from being full (United States Environmental Protection Agency).

6th Report of Session 2007–08 Waste Reduction suggested few options that are effective in waste reduction. One of them is to document the list of different waste production sites. Secondly such ideas should be imposed by companies that help in sustaining environmental resources. Third federal and governmental agencies and offices should make sure that waste is being dumped in a proper way. Proper laws should be passed and implemented that focus on environmental conservation and action should be taken against the one who breaches the law. At last the consumption of resources should be done in sustainable way (6th Report of Session 2007–08 Waste Reduction Volume I).

Chapter 3: Methodology

3.1. Research Methodology

Qualitative design and quantitative designs are two types of research designs either of which is used according to the nature of study (Mcleod, 2019). The design that has been used in this study is qualitative design because it is helpful to explore the challenges faced by the Ghanaian construction industry. The interviews that were conducted were through telephone, online video calls (Skype) and face-to-face with different industrial experts, to get a quicker response. Each interview will be conducted according to their personal preferences and their geographical location. Qualitative design is different from quantitative design as it is distinguished by its aims which means it is more of understanding based design which is related to the aspects of cultural and social life (McCusker and Gunaydin, 2015). Interviews were conducted with industrial experts, managerial employees of construction company in Ghana, contractors and project managers and on-location workers working on construction projects. These interviews have been helpful in providing first-hand knowledge about the reality of waste management in Ghana's construction industry. The interviews questioned the worker's role in waste reduction measures, in order to understand the perspective of workers from the construction industry.

According to McCusker and Gunaydin (2015), the qualitative methods give findings or the results in words rather than the numbers. The data in qualitative design is also analysed on word level analysis or content analysis unlike the statistical analysis which is performed in quantitative studies (McCusker and Gunaydin, 2015). The primary purpose of conducting interview is to get subjective perception of multiple participants working in construction industry of Ghana. Moreover, the interview would assist the researcher in presenting critical arguments of respondent based on practices and challenges associated with waste management in construction industry of Ghana.

3.2. Research Philosophy

The research philosophy for this research was realism. Realism is the sub branch of epistemology which is pertinent to finding the reality of truth and the existence of objects from the perspective of the human mind. Realism is of further two types which are, direct realism and critical realism. Direct realism is related to what our senses perceive with respect to the real world and critical realism is the sensation of images of the real world and not reality. The first aspect depicts the level of research capacity and the second depicts the importance of levels of study on multiple levels (GuhaThakurta and Chetty, 2015).

3.3. Research Approach

Since, the detailed observation of real world has been done for this research to assess the processes and challenges of waste management in the construction industry of Ghana, the researcher has employed the use of inductive approach for this study. Inductive reasoning is based on experience and what are the lessons learned from them. To reach conclusions, patterns and regularities are observed from experience (Dudovskiy, 2019).

3.4. Research Design

For this research descriptive research design has been used that enables the researcher in describing situation which is related to their field of research (Bhat, 2019). Furthermore, descriptive design is aimed at enlightening the researcher on what are the current issues within the area of research and is used to describe the characteristics and behaviour of the proposed population (Dudovskiy, 2019).

3.5. Data Collection Method

For this research, the data collection method employed in primary collection, as it provides first-hand knowledge about the source of information (Kabir, 2016). There are advantages of using primary qualitative analysis in the sense that data is collected by the researchers from a reliable source, but there are few disadvantages of employing the use of primary qualitative analysis, as in most cases the use of primary qualitative analysis will not supply answers to research question laid out by the researcher for their study and may not contain information specific for answering research questions. Moreover, data collected by primary means is often times liable to unspecific or irrelevant to the aims of the research. Literature has been reviewed to support the data collected through primary research, although the variables of the dataset in secondary research has differed from the current research that was carried out (Crossman, 2019). For the collection of primary data interviews have been conducted from industrial construction experts which would allow to gather data as direct information. The interviews were conducted according to the personal preferences of the participant and their geographical location. However, during the interview phase the issue of Corona Virus was identified as a global pandemic. Therefore, in order to follow government protocols, conducting face-to-face interviews became unfeasible. To overcome this problem Skype, phone calls and other social media websites were used to collect relevant information. For successful completion of interviews over Skype or phone calls, the researcher emailed the participants of the study and scheduled a time and date that would be feasible for the participants to provide answer for the questions asked. Furthermore, interview over telephone or Skype allowed the researcher to gather concentrated information from the participants and in addition it was easier to conduct.

3.6. Sampling Method, Technique and Sample Size

The two sampling methods are probability sampling and non-probability sampling (Taherdoost, 2016). In this particular study the sampling method which has been used is non-probability sampling and the sampling technique is snowball sampling. The data has been collected by the group interviews. The objectives of snowball sampling are to identify the interests and to delve into the cases of sampled people, in order to investigate the common and similar characteristics (Palinkas et al., 2013). The interviews were conducted from 30 participants which include industrial experts, managerial employees of construction company, contractors and project managers in Ghana and on-location workers working on construction projects.

3.7. Data Analysis

As the data collected is primary and qualitative, the method of analysis employed is thematic, in order to find the best results. To find the challenges and solutions Ghana is facing in regard to the waste management, thematic analysis has been done on the data to identify key patterns. Terry et al. (2017) has identified thematic analysis as an effective data analysis method, due to the six step procedure that helps to find meaningful patterns in the data collected. The six steps are, familiarisation with the data of Ghanaian construction industry, assigning codes to different subsectors for description, identifying themes across different codes, reviewing these themes, defining or naming such themes and producing a report based on the findings. Moreover, Perera (2017) describes PESTEL analysis as a key factor in exploring the market of an industry and external factors that affect a business. Therefore, a PESTEL analysis of the Ghanaian construction industry will be conducted as well.

3.8. Ethical Consideration

All the research done for this proposal has been paraphrased and cited and referenced accordingly. This research aims to be free from plagiarism. Any data that has been requested to be confidential will remain confidential.

3.9. Research Limitations

This research is limited to only Ghanaian construction industry and the challenges faced by them in order to reduce waste disposal. This study only focuses on what the construction industry in Ghana is doing in its power to manage waste disposal. If the focus area of this was broader then more data could be provided allowing this research to become more critical in nature and would allow to analyse the challenges faced from a global perspective.

Gantt chart

Task	Week 1	Week 2	Week 3	Week 4	Week 5	Week 6	Week 7	Week 8	Week 9	Week 10	Week 11
Topic Research											
Proposal											
Chapter: Introduction											
Chapter: Literature Review											
Chapter: Research Methodology											
Assessment of managers and construction worker in reducing waste produced											
Chapter: Data Collection											
Chapter: Data analysis											
Conclusion and Recommendation											

Chapter 4: Results and Findings

4.1 Introduction

According to Dranke and Hindle (2012), a huge amount of waste is generated from the projects undertaken in the construction industries; this process includes the consumption of raw materials in order to develop the product with the creation of several discarded items that are thrown away. Moreover, in order to treat and dispose this waste in an effective manner a sustainable way is utilised as the practice to manage the waste through different sorts of technologies or innovative solutions in order to save the environment from any sort of damage. The 3R's process is one of the best solutions of waste management done by reduce, reuse and recycle of the waste material (Brunner and Rechberger, 2015). Moreover, the construction industry of Ghana is an example of the productive industry with the best property projects and participates in the economy of the country therefore the country needs to consider the safe and effective solutions for waste management as there are number of environmental issues created by it. The greatest obstacle in waste management is the scarcity of funds from government and lack of key personnel in engineering (Osei-Kyei and Chan, 2017).

This chapter of the research is the critical analysis of research aim and objectives by carrying out detailed thematic analysis for the primary data collected through interviews from three participants including industrial expert, managerial employee who are on location workers of Construction Company, and project managers and in the commercial projects of construction industry of Ghana.

4.2 Thematic Analysis

4.2.1 Analysing the Waste Production in Commercial Construction Projects of Ghana

In the words of Bilal et al. (2016), one of the major issues that is faced by the construction industry of Ghana is waste production from the commercial projects as this has an impact on the efficient and sustainable working of the industry. Moreover, as analysed by Joshi and Ahmed (2016) there are various factors due which potential processes of waste management are essential to manage the different practices of the construction industry such as cement, wood, inventory wrappings and other types of construction waste. This makes the waste dispose of somewhere in a manner that harms the environment and people had to suffer with health issues. Furthermore it has also identified while conducting literature review that the waste generation is because of the release of harmful gases such as greenhouse gas emissions causing a serious damage to the environment by creating air pollution and water pollution particularly in Ghana as the use of natural resources and biodiversity is high in the country (Gangolells et al., 2014). One of the respondents who is an employee in Ghana construction industry was asked regarding the waste production and management in the during the commercial projects and he responded that:

"Being a worker at the site of the commercial project, I have experienced that there is huge amount of waste generation on day-to-day basis and the waste is either organic waste, solid waste, hazardous waste or recyclable waste. Different types of waste require different techniques of waste management but we don't have enough resources and funds from the government to manage the waste efficiently and we dispose of the waste. However, with the limited available resources we try to reuse the waste and manage it through the process of diversion where feasible."

Another interviewee was asked to highlight the common activities of waste reduction on construction sites and he stated that:

"Typically the waste is created due to demolition of building for land excavation, rail and road maintenance. The waste includes concrete, bricks, metal, plasterboard, timber, soil and rock and the use of natural resources for electricity production. This waste generation is due to improper facilities of waste reusability."

Further, a respondent who is a commercial project manager in construction industry of Ghana stated about the reasons behind waste reduction mentioned in the interview that:

"Due to lack of engineers in Ghana, the construction industry's municipal waste departments face issues in operating the equipment with the professional advice of sustainable practices such as sitting, construction, design and maintenance of facilities for waste disposal. Therefore, we are unable to manage the waste production and reduction at construction sites"

It can be analysed from the above statements that there are several reason behind the excessive waste production in the construction industry of Ghana whether it is the well-educated engineers or the proper provision of resources required to manage the harmful waste from the includes concrete, bricks, metal, plasterboard, timber due to the demolition and construction of buildings. Similarly, as stated by Aigbavboa, Ohiomah and Zwane (2017) in Ghana, inefficient waste management is due to the improper infrastructure of the industry, the site workers who are not properly trained and responsible towards their tasks, climate changes and inappropriate setup for the waste disposal, etc.

4.2.2 Assessing the Regional Issues of Construction Industry's Waste Production (500)

According to Agyekum (2012), the most productive construction industry in the continent of Africa is Ghanaian construction industry as the industry plays an important role in increasing the economy of the country. The challenges faced by the country are the global challenges as there are many countries that are unable to manage the waste and minimise its

harmful effects. For example, Adu-Boahen et al. (2014) stated that in Zambia and Zimbabwe there is a large amount of wastage bags, in South Africa the black polythene bags are seen everywhere in the country. However, Ghana being the construction industry hub needs to look after potential solutions of waste management with the improved precautions and excessive practices to manage the waste. One of the responses from the employee of the construction industry regarding the regional issues is stated below:

"The lack of funds is one issue but the rising prices of building materials and electricity also pose such challenges that we don't have enough budgets to manage the waste reduction practices. Therefore, we have to use the manual processes of waste management which are very time-consuming. Being a developing country we also lack in technological resources and thus it is another crucial issue for us to manage waste production."

The above statement explains that Ghana is a developing country and it is not easy for them to manage the waste through efficient and well-developed practices. Similarly, according to Adipah (2019), there are various regional issues and challenges in the construction industry of Ghana such that the lack of efforts by government to secure the health of people and the lack of the facilities to the construction sites such as the provision of funds for efficient applied disposal methods designed for the control of leachate flow and methane gas production.

4.2.3. Critically evaluating the Role of Construction Workers and Managers in Waste Management

Construction workers play a prominent role in managing the waste generated during construction work. As the research of Ding et al. (2018) in literature identified that construction workers tend to build storage facilities where the concrete and waste from other substances are stored for disposal. However, another study from literature indicated that construction workers have negative behaviour towards waste management as they find conventional practices of

working to be convenient (Yuan, 2013). However, during one of the interviews of construction worker, the respondent highlighted that:

"I have been working in construction from about four years. With the passage of time, new guidelines are provided to us for using resources optimally for minimising the generation of waste. Occasionally, the environmentalist came for an audit, they primarily criticise on the waste generated from construction and upon leaving give instruction to our manager for managing the waste that are mostly on recycling the waste".

The above respondent asserted that environmentalist push the managers for managing the waste and manager pushes the construction workers for waste management through recycling. Moreover, the respondent highlighted the materials such as doors and windows in good condition are major resources that can be reused in other construction projects and reduce overall ratio of waste at construction sites. Furthermore, the research of Zhang Wu and Shen (2012) from literature highlighted that managers are key players at construction sites for managing waste. The similar author added that managers ensure that new workers are given training on multiple waste management techniques to reduce the waste generated (Zhang, Wu and Shen 2012). In similar regard, one of the managers at construction site elaborated that:

"We, managers are given primal responsibility for controlling the waste of construction. Every manager use multiple techniques for waste management such as deconstruction, recycling and more. In my opinion, I personally prefer training the workers for generating minimum waste instead of instructing the workers to clean the waste after the work. When the workers know how to use the resources optimally, they will automatically control the waste generated from construction and reuse them"

From the above point of view of one manager, it can be evaluated that managers conduct proper training and development session for construction workers that allow them to control the waste generated from construction and increase their capability of using resources

optimally. According to the research of Yuan (2013) in literature, construction workers play a major role in demolition of the waste generated from construction, but it generates pollution and has environmental impacts. Thus, the managers instruct the construction workers for deconstruction rather than demolition of waste. However, when conducting the interview, one of the respondents indicated that

"One of the best things about our construction site is the action plan against waste management that involves various kind of techniques on reducing the waste, recycling the waste and deconstructing the waste which helps us in playing vital role in for bringing sustainability in environment through waste management"

The above response revealed that action plan guides the managers and construction workers for managing the waste and bringing sustainability in the environment.

4.2.4. Critically analysing the Challenges to Waste Reduction in the Commercial Projects of Construction Industry of Ghana

According to the study of Hussin, Rahman and Memon, (2013) in literature, the commercial construction projects in Ghana generates considerable waste that need to be controlled. However, to minimise the waste there are certain challenges which was mentioned in the research of (Liew, Sojobi and Zhang, 2017). The study of Liew, Sojobi and Zhang (2017) elaborated that one of the challenges for reducing the waste is the cost accounted for employing waste management techniques. However, during interview, one of the respondents highlighted: *"During my time here in construction industry, I realised that cost associated with managing the waste is major drawback and demotivating factor that discourages construction industry for taking steps against reducing the waste. Employees are hardly paid in full for their extra effort in commercial projects. In my opinion, lack of sufficient funds and high cost for waste management are major determinants that raised the challenge for us in reducing the waste."*

The above response of one participant identified that waste management incurs high cost that discouraged construction industry for investing in waste management and taking steps for controlling the waste. Additionally, the study of Alwan, Jones and Holgate (2017) in literature considered the poor planning to be major a challenge for reducing the waste in constructing industry. However, one the respondents highlighted in the interview that:

"From my experience, I think one of the major challenge for reducing waste in construction project is lack of interest of government in waste management. The government of Ghana is more focused towards the issue of deprivation of resource rather than waste management. Hence, construction industry of Ghana is less inclined towards controlling and managing the waste."

The above response of one construction worker indicated that government of Ghana has not been taking interest in waste management from construction sites. But instead, the government is focused towards provision of basic resources to deprive population of Ghana. The construction industry consider it as a challenge, as without government intervention, no construction projects think of controlling the waste. Furthermore, the study of Hussin, Rahman and Memon, (2013) in literature asserted that affordability has been one of the challenges that discouraged construction industry to employ waste management techniques. The similar researcher elaborated that most construction projects has to pay additional cost for gathering the required resources for building which do not leave them with any funds for managing the waste from construction (Douti, Abanyie and Ampofo, 2017). In similar manager, one the respondents stated in an interview that:

"According to my opinion, most construction industries spend great amount of funds on arranging the resources of construction. Hence, they cannot afford to spend more on things like waste management, as the stakeholders do not prefer additional cost after paying more

for raw materials and construction equipment which consequently restrict managers and workers to take any step against waste management"

The above response evaluated that affordability is one of the challenge that restrict construction industry for taking any step against waste management, as the participant highlighted that construction project has to pay extra cost for gathering raw material and construction equipment which do not leave them with any funds to spend on waste management.

4.2.5 Identifying the Solutions for Waste Management in Construction Industry of Ghana

Hussin, Rahman and Memon (2013) the average amount of waste produced in the construction industry totals to 9% of all the products that are used, and this includes waste of cement, steel, plastic and other materials that can be easily used. Hence it is important for the construction industry of Ghana to formulate methods or solutions for waste management in order to avoid damaging the environment and the health and safety of the citizens. As such, the study of Udawatta et al. (2015) has explained that in order to reduce waste, the citizens or individuals must first be aware of the generation of waste. This can be achieved by providing training to individuals and employees of the construction industry about the materials that produce large amounts of waste and damage the environment and methods on how to inhibit the generation of waste as well. Furthermore, Zuo et al. (2015) provides a solution regarding the modification on the cultural trend in the construction industry and has suggested the introduction of a legislation that provides an effective strategy to minimise the reduction of wastes. Although in Ghana the municipal organisations are incompetent, global administrative bodies like the UN has set-up rules and monitoring bodies over the construction industry of Ghana to ensure they manage the waste produced in an efficient manner (Owusu-Sekyere, Bagah and Quansah, 2015). Another possible solution for the management of waste in the

construction of Ghana is to remove the political barriers to enhance the credibility and management, and implement policies that would require organisations to train their staff regarding methods on waste management in order to ensure a cultural shift from conventional methods to sustainable practices in construction projects. A response obtained from a participant is as follows:

"In our construction industry, we are making efforts to implement different solutions and strategies to effectively manage wastes. We are using raw materials of certain properties that allows us to reduce the waste generated and using different technologies as well to further reduce waste. I think in the long run we will be able to ensure less production of waste and ensure a clean and green environment"

From the analysis of the above response, it can be noted that the participant explains that within the construction industry of Ghana organisations and employees are making their best efforts to ensure reduction of waste produced. They are employing the use of certain raw materials which allows them to reduce waste. This finding can also be validated from the study of Ayarkwa, Agyekum and Adinyira (2011) where the authors describe that in Ghana raw materials are being used before their chemical properties change and are ensuring to use all other substance and products whose change in chemical properties would affect the environment. Further analysis of the response depicts that, the construction industry of Ghana is also employing the use of technology to ensure reduction of waste produced and as explained in the study of Agyekum (2012) making the employees knowledgeable of waste disposal technologies and techniques and providing them with regular training, the construction industry of Ghana will be able to alter the waste disposal activities extensively.

4.3 Discussion

4.3.1 The role of commercial construction projects in Ghana in producing waste and measures

The major source of waste in the construction industry is the release of harmful gases from the use of non-renewable resources such as carbon dioxide which is released due to the steel production and contributes in the production of energy-intensive product (Ametepey and Ansah, 2014). Farr-Wharton, Foth and Choi (2013) further elaborated that the greater part of this waste, including waste of construction material is dumped on land that contribute 8% in the global discharges of ozone reduction substance such as CO_2 gas. Moreover, Haas et al. (2015) agreed that only 28% of this waste gets reused, which implies that 72% of worldwide waste is disposed of without being processed. In view of these discoveries, it very well may be contended that the construction business adds to waste generation, yet additionally corrupts the

earth because of the crude items used. Moreover, the findings of the study analysed that, the consumption of raw materials in the commercial construction projects also contributed to the huge amount of waste generation which degrades the environment and cause damage in terms of air pollution and water pollution. The findings further discusses the types of waste material which are produced such as organic waste, solid waste, hazardous waste or recyclable waste which contaminated the environment. However Ahadzie (2019) identified the lack of government policies in Ghana and the incompetence of the contractors as the factor aiding the damage to the environment from this industry. Whereas Osei-Kyei and Chan (2017) highlighted the scarcity of government funds as the greatest barrier in the management of waste and also the lack of significant filters in the engineering sector. Similarly, the findings also identified the lack of resources and the funds from the government as the significant factor behind the lack of management of the waste in construction industry. However, as stated by Cobbinah, Black and Thwaites (2015) the major contributor in the waste generation of the Ghanaian construction industry is high levels of pollution that are causing irreversible damage and land pollution.

Ametepey and Ansah (2014) led a study on the construction business of Ghana by directing overviews with the labourers, business administrators and other key partners and distinguished ten significant wellsprings of contamination for Ghana development industry, utilisation of crude material, infringement practices, interfering with the nearby vegetation and fauna, water contamination, power utilisation, land contamination, particulate issue (PM), solid waste and non-renewable energy source use. Similarly, in the words of Adipah (2019), in Ghanaian construction industry the major sources of pollution includes the electricity consumption, encroachment activities, consumption of raw materials, noise pollution, solid waste particulate matter and the use of fossil fuels. Among these significant sources of contamination, are mostly identified with waste creation and their administration. In this way,

it is apparent that the most concerning issue for the development business in Ghana is its waste creation, as PM or strong waste. Cobbinah, Black and Thwaites (2015) stated that it is essential to beat this issue since waste productions in such high amounts in Ghana can bring about an enormous harm to nature and biodiversity of the nation, the study further outlines this can influence the economy of the nation by impacting jobs for the rustic populace. Whereas, the research findings explored that the major sources of pollution in the construction industries are classified them into four categories organic waste, solid waste, hazardous waste or recyclable waste. In the current study, it has also explored that the most waste is generated from land excavation by the demolition of buildings (Adu-Boahen et al., 2014). The management of waste is not as efficient as required for the sustainable environment in Ghana due to lack of engineers, technological resources and government funds and initiatives for waste management therefore there is no practices of efficient waste reduction activities (Adu-Boahen et al., 2014).

4.3.2 The role of construction workers and project managers in implementing waste reduction practices in Ghana

The second objective of the study was to identify the role of construction workers and project managers in implementing waste reduction practices in Ghana. By examining several studies in the literature such as Poon et al. (2013) which states that construction site workers and project managers can assume a key job in the green waste decrease practices to be utilised on local construction, however workers typically have a negative perception about any changes in their regular strategies for working because of which these workers are not open to changing their practices, so as to guarantee waste management practice in the construction industry. Furthermore the study of Zhang, Wu and Shen (2012), has distinguished specialists or workers on a construction site as boundaries to turning construction industry reasonable, as they continue with practices that are uneconomical and create was and focuses on the information

that shows extreme misfortunes to biodiversity, water and soil quality because of construction trash and waste. Poon et al (2013) argued that in spite of the fact that, construction workers can assume a more prominent job in guaranteeing waste decrease by leading waste arranging works on, reusing material, reusing total and in general maintaining a strategic distance from waste creation at each phase of construction in Ghana. Furthermore, the thematic analysis revealed that environmentalist pushes the project managers for incorporating recycling techniques at construction so that the construction workers actively participate in reducing the waste via recycling.

Additionally, some studies in literature specified that construction workers do not find the practices of waste management appropriate and prefer conventional method working. The study of Yuan (2013) is one which discusses the significance of construction workers as it states that supervisors as a rule organise time saving and financially beneficial practices more than waste management activities, subsequently staff preparing on waste management is definitely not a typical practice which indicates the general issue, as the absence of information in labourers prompts perilous working conditions, in which items are used uneconomically. In this way, there is a need to prepare the local specialists of Ghana, from managers, contractual workers and even key partners to organise waste managing strategy. This is supported by the response of participants which when analysed concluded that project managers uses different approaches for the issue of waste management in Ghana construction industry which varies according to their perception of the issue, they initiate training session for construction workers to teach the techniques of using resources optimally and the process of deconstruction which played a prominent role in implementing waste management practices at construction sites of Ghana. It was further identified through the response of a participant

4.3.3 The challenges being encountered in waste reduction in commercial project within the Ghanaian construction industry

The third objective of the study was to highlight the challenges being encountered in waste reduction in commercial project within the Ghanaian construction industry. The study of Hussin, Rahman and Memon (2013) stated that development extends on a normal waste 9% of the absolute items that are utilised which incorporates wasting concrete, steel, plastic and different materials that can be effectively utilised. The study of Liew, Sojobi and Zhang (2017) in terms of cost includes that reasonableness is another factor for applying waste management in construction industry. Alwan, Jones and Holgate (2017) argued that cost is certainly not a significant issue as the basic culture inside the business of sparing expense is the problem, it contends that practices for decrease in waste are regularly considered as an unnecessary thing which isn't required for the improvement of their practices. Enchill and Mireku (2014) study identified the lack of understanding towards the concepts of maintenance of collection, heat recovery of waste, transfer system for waste. Whereas Hussin, Rahman and Memon (2013) identified the cost of the practices as the major challenge as majority of the projects in the Ghana construction industry exceeds the initial budget limit set for the project and the stakeholders are reluctant to add the cost of waste management. By examining these researches in literature, it has been found that there are various primal factors that raised challenges for Ghanaian construction industry to implement waste reduction practices. However, the analysis of one the themes identified that Ghanaian construction industry has to pay extra cost for generating raw material and construction equipment which does not leave them with extra funds to be spent on waste management. Additionally, study of Ametepey, Aigbavboa and Ansah (2015), which discusses the lack of awareness of the management practices, the waste workers poor work conditions as the major issue in waste management concluded the issue of affordability and lack of resources as challenges for controlling and managing the waste

generated from commercial projects. While, the findings revealed that lack of government interest in waste management created challenge for Ghanaian construction industry in reducing the waste from commercial projects as the government of Ghana focuses more on the resource lack in the construction industry rather than the use of these resources in the most efficient manner for reducing the waste creating which highlights the absence of understanding of the specialists on governmental level about the relation between the practices creating waste and the resource depreciation.

4.4 Chapter Summary

The chapter assessed the waste production and management practices in the commercial projects of the construction industry of Ghana. Five major themes were explored to analyse the research objectives and present valuable results. Waste production in Ghanaian construction industry is in excessive amounts as there are a number of projects that are carried out in the country necessary for adding value to the country's GDP. However, there are few practices such as reusability of raw material is practiced to manage waste but still it is causing air, water and land pollution due to the use of hazardous materials and non-renewable energy sources. Further, being a developing country, the major regional issues are lack of technological resources and government funds. The current chapter found that project managers play an active role in implementing waste reduction practices in Ghanaian construction industry by incorporating training and development sessions for construction workers to improve their recycling and deconstructing skills. Additionally, the environmentalist in Ghana insist the managers for implementing waste management practice at commercial project by providing instruction on using resources optimally to generate minimum wastes. Furthermore, the findings revealed that lack of government interest, high cost and affordability are key

determinants that raised the challenges for construction workers in incorporating waste management technique during commercial projects.

Chapter 5: Conclusion

5.1 Summary of Findings

The study identifies the challenges that are responsible for encouraging the reduction of waste in commercial projects within the construction industry of Ghana. Furthermore, the study gathered responses through interviews and assessed the findings emerging from the themes of the interviews. Therefore, the findings of the study suggest that the construction workers are responsible for performing a noticeable role in the management of waste which is created during the work of construction. Similarly, the study also identifies that the construction workers are often responsible for building storage facilities where waste is stored for disposal. Similarly, the findings also indicate that the construction workers often hold a negative perception towards waste management practices because they prefer to work with the conventional working methods more convenient. Therefore, according to the findings of the study, environmentalists push the managers for managing the waste, and the manager pushes the construction workers for waste management through recycling. The research also highlights that the materials of doors and windows are the major resources that are reused in construction projects resulting in the reduction of waste at the site of construction. Similarly, the managers also ensure that new workers are given training on multiple waste management techniques for waste reduction. Therefore, the managers instruct the construction workers for deconstruction rather than demolition of waste.

The findings of the study mention that the construction of commercial projects in Ghana requires extensive control of waste generated due to a lack of waste management practices. Therefore, the study also evaluates the challenges and discusses that the major challenge associated with waste management is the cost required for the implementation of waste management techniques. Therefore, the findings of this study explore the idea that waste management incurs a high cost that discourages the construction industry to invest in waste

management and take steps to control the waste. The responses in the analysis also discuss that the government of Ghana does not take interest in managing waste present at the construction sites. Furthermore, the construction projects also have to pay extra costs to obtain raw material and equipment which creates a lack of funding to take initiatives of waste management. The study also mentions that the Ghanaian construction industry is making extensive efforts to ensure the reduction of waste by employing the use of raw materials and technology.

5.2 Conclusion

The study aims to identify the challenges that encourage activities of waste reduction in the commercial projects of the construction industry of Ghana. Therefore, the study focuses on determining the role of commercial construction projects in Ghana that produce waste and the measures that are adopted to curb it. Therefore, the study provides relevant recommendations to effectively assess the waste reduction in commercial projects within the industry of Ghana. The study also evaluates the role of construction workers and project managers in the implementation of waste reduction practices for the construction of commercial projects. The study concludes that the role of construction workers and project managers is essential in the practices of green waste reduction and its implementation on construction sites. Moreover, the workers also often perceive negatively to any changes that affect their conventional working methods. The study further identifies that the workers and labourers at the site of construction have the role of acting as a barrier which limits the sustainability in the construction industry because of their uneconomic and environmentally damaging practices. However, the study also concludes that the workers often perform a greater role in ensuring the reduction of waste through the adoption of practices associated with waste sorting, recycling material and aggregate, and avoiding the production of waste at different stages of building.

The role of project managers is also considered as critical in ensuring the activities of waste management. Therefore, the study identifies that the role of project managers is important because they are often about green practices on construction sites. Similarly, project managers are considered important because the compliance of lower staff is based on the actions of higher executives. The study also identifies the challenges that are encountered in the waste reduction of commercial projects in the construction industry of Ghana. Therefore, the study identifies that major challenges in the construction industry of Ghana which is associated with a high ratio of generated waste as compared to different sectors such as factories. Similarly, the high ratio in the creation of waste is due to the challenges of cost. According to the findings of the study the challenge of cost is a major issue for waste reduction and is considered as the top priority of project managers and workers due to the cost-saving in the stages of building processes. Similarly, the challenge of affordability is also a major issue that harms the implementation of waste management practices in the industry of construction in Ghana. Therefore, the study concludes that the solutions for waste management are expensive which creates a lack of affordability resulting in decreased waste management practices.

5.3 Recommendations

Commercial construction projects and buildings are known for generating significant amounts of waste and materials. Therefore, the stakeholders, project managers, owners, and stakeholders can adopt various practices to improve the management of waste at construction sites, minimise costs, and increase sustainability. Similarly, successful construction operations often seek ways to reduce costs and enhance functional efficiencies. Therefore, commercial projects can achieve sustainability by controlling and regulating the costs of building and take effective steps to create a sustainable business.

- Commercial projects should contain designs at the initial stages of the project that result in the creation of less waste. Moreover, rework caused due to poor workmanship and errors should be minimised.
- It is recommended that standard sizes and quantities of materials should be used to plan for the reduction of offcuts. Furthermore, excess use and ordering of materials should be limited.
- Deliveries should be arranged to match the work stages and storage of materials on-site should be avoided. Furthermore, the safety of the storage areas is necessary and it is recommended that the areas are secure, safe, and waterproof.
- It is recommended that instead of using new materials off-cuts should be collected and used. Furthermore, coordination of trade is essential for waste management to ensure that the leftover materials can be recycled. Similarly, temporary materials should be fixed so that they can be reused under suitable settings. The unused materials on the site should also be returned, sold, or donated.
- Contacting waste contractors can also enable waste management and encourage recycling.
- Waste assessment practices should be adopted to gain information regarding the activities of waste reduction. Therefore, effective education and communication should be developed among the workers to ensure that waste reduction policies are implemented.

5.4 Future Implications

This research can be considered as important for construction companies in the region of Ghana and different parts of the world because the study offers a detailed and profound

understanding of the construction industry and waste reduction challenges that are faced in commercial projects. Furthermore, this study will also effectively provide prospects for multiple construction companies to create waste management awareness and improve the standards of sustainability in the construction industry. Stakeholders and investors can also attain valuable information through this research as it will allow them to become vocal regarding the waste management practices that are important in the construction sector. Moreover, the study also effectively discusses the role of workers and project managers in the implementation of waste reduction practices for the construction of commercial projects which can be identified by the senior executives to engage with the matter of waste management and ensure that sustainable practices are adopted. Similarly, assessing the challenges that are encountered in the construction industry of Ghana associated with the waste reduction can be properly assessed by local authorities to develop appropriate plans which effectively minimise the challenges in the Ghanaian construction industry and ensure sustainability.

References

Adipah, S., 2019. Challenges and Improvement Opportunities for Accra City MSWM System. *J. Environ. Sci*, *3*, pp.133-146.

Adu-Boahen, K. *et al*, 2014. Waste management practices in Ghana: challenges and prospect, Jukwa Central Region. *International Journal of Development and Sustainability*, *3*(3), pp.530-546.,

Agyekum, K., 2012. *Minimizing materials wastage at the construction stage of a project through the implementation of lean construction* (Doctoral dissertation).

Ahadzie, D. K. 2019. Ghana's construction industry is lively but needs regulation. *The Conversation.* [Online] Viewed 11 April 11, 2020. Available at: https://theconversation.com/ghanas-construction-industry-is-lively-but-needs-regulation-124733

Ahmed, K., Hatira, L. and Valva, P., 2014. The construction industry in Ghana, West Africa–how can the construction industry in Ghana become sustainable?. *School of Engineering. Karlskrona, Sweden: Blekinge Institute of Technology*.

Aigbavboa, C., Ohiomah, I. and Zwane, T., 2017. Sustainable construction practices:"a lazy view" of construction professionals in the South Africa construction industry. *Energy Procedia*, *105*, pp.3003-3010.

Ajayi, S.O., Oyedele, L.O., Bilal, M., Akinade, O.O., Alaka, H.A. and Owolabi, H.A., 2017. Critical management practices influencing on-site waste minimization in construction projects. *Waste management*, *59*, pp.330-339.

Ajayi, S.O., Oyedele, L.O., Bilal, M., Akinade, O.O., Alaka, H.A., Owolabi, H.A. and Kadiri, K.O., 2015. Waste effectiveness of the construction industry: Understanding the

impediments and requisites for improvements. *Resources, Conservation and Recycling*, *102*, pp.101-112.

Alwan, Z., Jones, P. and Holgate, P., 2017. Strategic sustainable development in the UK construction industry, through the framework for strategic sustainable development, using Building Information Modelling. *Journal of Cleaner Production*, *140*, pp.349-358.

Ametepey, O., Aigbavboa, C. and Ansah, K., 2015. Barriers to successful implementation of sustainable construction in the Ghanaian construction industry. *Procedia Manufacturing*, *3*, pp.1682-1689.

Ametepey, S.O. and Ansah, S.K., 2014. Impacts of construction activities on the environment: the case of Ghana. *Journal of Construction Project Management and Innovation*, *4*(Supplement 1), pp.934-948.

Amoah, S.T. and Kosoe, E.A., 2014. Solid waste management in urban areas of Ghana: issues and experiences from Wa.

Ayarkwa, J., Agyekum, K. and Adinyira, E., 2011. Exploring waste minimization measures in the Ghanaian construction industry. Procs West Africa Built Environment Research (WABER) Conference.

Bhat, A. (2019). *Research Design: Definition, Characteristics and Types | QuestionPro*. [online] QuestionPro. Available at: https://www.questionpro.com/blog/research-design/ [Accessed 12 Nov. 2019].

Bilal, M. *et al.* 2016. Big data architecture for construction waste analytics (CWA): A conceptual framework. *Journal of Building Engineering*, *6*, pp.144-156.

Brunner, P.H. and Rechberger, H., 2015. Waste to energy–key element for sustainable waste management. *Waste management*, *37*, pp.3-12.

Budica, I. *et al.* 2015. Waste management as commitment and duty of citizens. *Polish Journal of Management Studies, 11*.

Cobbinah, P.B., Black, R. and Thwaites, R., 2015. Biodiversity conservation and livelihoods in rural Ghana: Impacts and coping strategies. *Environmental Development*, *15*, pp.79-93.

Cobbinah, P.B., Gaisie, E. and Owusu-Amponsah, L., 2015. Peri-urban morphology and indigenous livelihoods in Ghana. *Habitat International*, *50*, pp.120-129.

Conserve Energy Future. (2020). Various Waste Disposal Problems and Some Fantastic Solutions - Conserve Energy Future. [online] Available at: https://www.conserve-energy-future.com/various-waste-disposal-problems-and-solutions.php [Accessed 24 Jan. 2020].

Corwin, J.E., 2018. "Nothing is useless in nature": Delhi's repair economies and value-creation in an electronics "waste" sector. *Environment and Planning A: Economy and Space*, *50*(1), pp.14-30.

Crossman, A. (2019). *Is Secondary Data Right for Your Research Project?*. [online] ThoughtCo. Available at: https://www.thoughtco.com/secondary-data-analysis-3026536 [Accessed 28 Nov. 2019].

Dahlbo, H. *et al.* 2015. Construction and demolition waste management–a holistic evaluation of environmental performance. *Journal of Cleaner Production*, *107*, pp.333-341.

Das, S. and Bhattacharyya, B.K., 2015. Optimization of municipal solid waste collection and transportation routes. *Waste Management*, *43*, pp.9-18.

Ding, Z., Zhu, M., Tam, V.W., Yi, G. and Tran, C.N., 2018. A system dynamics-based environmental benefit assessment model of construction waste reduction management at the design and construction stages. *Journal of Cleaner Production*, *176*, pp.676-692.

Djokoto, S.D., Dadzie, J. and Ohemeng-Ababio, E., 2014. Barriers to sustainable construction in the Ghanaian construction industry: consultants perspectives. *Journal of Sustainable Development*, *7*(1), p.134.

Douti, N.B., Abanyie, S.K. and Ampofo, S., 2017. Solid waste management challenges in urban areas of Ghana: A case study of Bawku Municipality.

Dudovskiy, J. (2019). Descriptive Research - Research-Methodology. Retrieved 12 November 2019, from https://research-methodology.net/descriptive-research/

Dudovskiy, J. (2019). Inductive Approach (Inductive Reasoning) - Research-Methodology. Retrieved 12 November 2019, from https://research-methodology.net/research-methodology/research-approach/inductive-approach-2/

Encyclopaedia Britannica. 2020. Solid-Waste Management. *Britannica.com.* [Online] Viewed 11 April 2020. Available at: https://www.britannica.com/technology/solid-waste-management

Farr-Wharton, G., Foth, M. and Choi, J.H.J., 2013, September. EatChaFood: challenging technology design to slice food waste production. In *Proceedings of the 2013 ACM conference on Pervasive and ubiquitous computing adjunct publication* (pp. 559-562).

Gangolells, M. *et al.* 2014. Analysis of the implementation of effective waste management practices in construction projects and sites. *Resources, conservation and recycling*, *93*, pp.99-111.

Gelb, A., Meyer, C. and Ramachandran, V., 2014. Development as diffusion: manufacturing productivity and sub-Saharan Africa's missing middle. *Center for Global Development Working Paper*, (357).

Gelb, A., Meyer, C. and Ramachandran, V., 2014. Development as diffusion: manufacturing productivity and sub-Saharan Africa's missing middle. *Center for Global Development Working Paper*, (357).

Ghana Environmental Protection Agency (2002), Newsletter. Vol. 5 no. 2 July-December 2002. EPA, Accra

GuhaThakurta, S. and Chetty, P. (2015). *Understanding research philosophy*. [online] Knowledge Tank. Available at: https://www.projectguru.in/publications/research-philosophy/ [Accessed 12 Nov. 2019].

Haas, W., Krausmann, F., Wiedenhofer, D. and Heinz, M., 2015. How circular is the global economy?: An assessment of material flows, waste production, and recycling in the European Union and the world in 2005. *Journal of industrial ecology*, *19*(5), pp.765-777.

Heacock, M. *et al.* 2015. E-waste and harm to vulnerable populations: a growing global problem. *Environmental health perspectives*, *124*(5), pp.550-555.

Huang, B. *et al.* 2018. Construction and demolition waste management in China through the 3R principle. *Resources, Conservation and Recycling*, *129*, pp.36-44.

Hussin, J.M., Rahman, I.A. and Memon, A.H., 2013. The way forward in sustainable construction: issues and challenges. *International Journal of Advances in Applied Sciences*, *2*(1), pp.15-24.

Hussin, J.M., Rahman, I.A. and Memon, A.H., 2013. The way forward in sustainable construction: issues and challenges. *International Journal of Advances in Applied Sciences*, *2*(1), pp.15-24.

Joshi, R. and Ahmed, S., 2016. Status and challenges of municipal solid waste management in India: A review. *Cogent Environmental Science*, *2*(1), p.1139434.

Kheni, N.A., 2014. Sustainable Waste Material Management: The Role of Hnd Programmes In Ghana, Volume 3, Issue 2, PP.15-23

Liew, K.M., Sojobi, A.O. and Zhang, L.W., 2017. Green concrete: Prospects and challenges. *Construction and building materials*, *156*, pp.1063-1095.

Liu, T. *et al.* 2015. Urban household solid waste generation and collection in Beijing, China. *Resources, Conservation and Recycling*, *104*, pp.31-37.

Manahan, S.E., 2017. *Industrial ecology: environmental chemistry and hazardous waste*. Routledge.

Marrero, M., Puerto, M., Rivero-Camacho, C., Freire-Guerrero, A. and Solís-Guzmán, J., 2017. Assessing the economic impact and ecological footprint of construction and demolition waste during the urbanization of rural land. *Resources, Conservation and Recycling*, *117*, pp.160-174.

Marzouk, M. and Azab, S., 2014. Environmental and economic impact assessment of construction and demolition waste disposal using system dynamics. *Resources, conservation and recycling*, *82*, pp.41-49.

McCusker, K. and Gunaydin, S., 2015. Research using qualitative, quantitative or mixed methods and choice based on the research. *Perfusion*, *30*(7), pp.537-542.

Miezah, K. *et al.* 2015. Municipal solid waste characterization and quantification as a measure towards effective waste management in Ghana. *Waste Management*, *46*, pp.15-27.

Moh, Y.C. and Manaf, L.A., 2014. Overview of household solid waste recycling policy status and challenges in Malaysia. *Resources, Conservation and Recycling*, *82*, pp.50-61.

Njoroge, B.N.K., Kimani, M. and Ndunge, D., 2014. Review of municipal solid waste management: A case study of Nairobi, Kenya. *International Journal of Engineering and Science*, *4*(2), pp.16-20.

Ofstad, S. *et al.* 2017. Understanding the mechanisms behind changing people's recycling behavior at work by applying a comprehensive action determination model. *Sustainability*, *9*(2), p.204.

Osabutey, E.L. and Croucher, R., 2018. Intermediate institutions and technology transfer in developing countries: The case of the construction industry in Ghana. *Technological Forecasting and Social Change*, *128*, pp.154-163.

Osei-Kyei, R. and Chan, A.P., 2017. Implementing public–private partnership (PPP) policy for public construction projects in Ghana: critical success factors and policy implications. *International Journal of Construction Management*, *17*(2), pp.113-123.

Oteng-Ababio, M., Amankwaa, E.F. and Chama, M.A., 2014. The local contours of scavenging for e-waste and higher-valued constituent parts in Accra, Ghana. *Habitat International*, *43*, pp.163-171.

Owusu-Sekyere, E., Bagah, D.A. and Quansah, J.Y.D., 2015. The Urban Solid Waste Management Conundrum in Ghana: Will It Ever End?

Owusu-Sekyere, E., Bagah, D.A. and Quansah, J.Y.D., 2015. The urban solid waste management conundrum in Ghana: will it ever end?.

Palinkas, L.A., Horwitz, S.M., Green, C.A., Wisdom, J.P., Duan, N. and Hoagwood, K., 2015. Purposeful sampling for qualitative data collection and analysis in mixed method implementation research. *Administration and policy in mental health and mental health services research*, *42*(5), pp.533-544.

Perera, R., 2017. *The PESTLE analysis*. Nerdynaut.

Poon, C.S., Yu, A.T., Wong, A. and Yip, R., 2013. Quantifying the impact of construction waste charging scheme on construction waste management in Hong Kong. *Journal of construction engineering and management*, *139*(5), pp.466-479.

Ravindra, K., Kaur, K. and Mor, S., 2015. System analysis of municipal solid waste management in Chandigarh and minimization practices for cleaner emissions. *Journal of Cleaner production*, *89*, pp.251-256.

Suleman, Y., Darko, E.T. and Agyemang-Duah, W., 2015. Solid waste disposal and community health implications in Ghana: Evidence from Sawaba, Asokore Mampong municipal assembly. *J Civil Environ Eng*, *5*(6).

Taherdoost, H., 2016. Sampling methods in research methodology; How to choose a sampling technique for research.

Terry, G., Hayfield, N., Clarke, V. and Braun, V., 2017. Thematic analysis. *The Sage handbook of qualitative research in psychology*, pp.17-37.

Udawatta, N., Zuo, J., Chiveralls, K. and Zillante, G., 2015. Attitudinal and behavioural approaches to improving waste management on construction projects in Australia: benefits and limitations. *International journal of construction management*, *15*(2), pp.137-147.

Udawatta, N., Zuo, J., Chiveralls, K. and Zillante, G., 2015. Improving waste management in construction projects: An Australian study. *Resources, Conservation and Recycling*, *101*, pp.73-83.

UNEP. 2020. Solid Waste Management. *The United Nations.*[Online] Viewed 11 April 2020. Available at: https://www.unenvironment.org/explore-topics/resource-efficiency/what-we-do/cities/solid-waste-management

Veitch, C. (2017). *The Construction Industry in Ghana :: Ghana*. [online] Whoownswhom.co.za. Available at: https://www.whoownswhom.co.za/store/info/4483 [Accessed 28 Nov. 2019].

White, P., Dranke, M. and Hindle, P., 2012. *Integrated solid waste management: a lifecycle inventory*. Springer Science & Business Media.

Yuan, H., 2013. A SWOT analysis of successful construction waste management. *Journal of Cleaner Production*, *39*, pp.1-8.

Yuan, H., 2013. Key indicators for assessing the effectiveness of waste management in construction projects. *Ecological Indicators*, *24*, pp.476-484.

Zhang, X., Wu, Y. and Shen, L., 2012. Application of low waste technologies for design and construction: a case study in Hong Kong. *Renewable and sustainable energy reviews*, *16*(5), pp.2973-2979.

Environmental Protection Council;Ghana - Environmental action plan (English) Retrieved from http://documents.worldbank.org/curated/en/278211468751766859/Ghana-Environmental-action-plan Accessed on 06-08-2020.

Adjarko, H., Gemadzie, J. and Agyekum, K., 2016. Construction related environmental laws and policies in Ghana: a literature review.

Yeboah, K. & Mensah A.A.T., 2014. 40 Years of environmental protection in Ghana: Footprints from EPC to EPA Retrieved from https://www.graphic.com.gh/features/features/40-years-of-environmental-protection-in-ghana-footprints-from-epc-to-epa.html Accessed on 06-08-2020.

Ali, S.F., Ali, A. and Bayyati, A., 2018, November. Factors affecting the construction waste management in terms of refurbishing, reusing or recycling. In *The 5th International Project and Construction Management Conference" IPCMC2018"*.

Al-Rifai, J.A.R. and Amoudi, O., 2016. Understanding the key factors of construction waste in Jordan. *Jordan Journal of Civil Engineering*, *10*(2).

McAllister, J., 2015. Factors influencing solid-waste management in the developing world.

Owusu-Nimo, F., Oduro-Kwarteng, S., Essandoh, H., Wayo, F. and Shamudeen, M., 2019. Characteristics and management of landfill solid waste in Kumasi, Ghana. *Scientific African*, p.e00052.

Barsalou, O. and Picard, M.H., 2018. International environmental law in an era of globalized waste. *Chinese Journal of International Law, 17*(3), pp.887-906.

United States Environmental Protection Agency. Managing and Reducing Wastes: A Guide for Commercial Buildings *Retrieved from https://www.epa.gov/smm/managing-and-reducing-wastes-guide-commercial-buildings Accessed on 06-08-2020.*

Appendix A: Interview Questions

1. What is your role of working in the construction industry?
2. How long have you been working in the industry?
3. Was your role in the construction industry include handling raw material or discarding waste?
4. Do you consider the Ghanaian construction industry to have a waste management issue?
5. If yes, what are the specific issues you would like to highlight?
6. Do you experience any waste reduction activities on construction site?
7. Have you personally ever been a part of waste management or reduction practices on construction sites?
8. Do you know of any policy or current waste management practices?
9. As a construction worker/project manager, do you consider green initiatives to better or worse than conventional methods employed during construction?
10. What is the biggest challenge to sustainability in waste management practices of the Ghana construction industry?
11. What would you suggest as a solution to managing the issue of waste production in the construction industry of Ghana?