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Factors Affecting the Implementation of Sustainable Construction in Ghana: the Architect's Perspective

by

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DECLARATION

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

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ABSTRACT

Urbanization and industrialization are having a great impact on the earth's ecosystem: environmental degradation, pollution, climate change and poverty. This menace has

brought to the forefront the need for sustainable development in the built environment. Though construction practitioners in Ghana are aware of sustainable construction practices, there is lack of evidence on its implementation in the country. This study investigates, from the Ghanaian architects' perspective, the level of implementation, the barriers and drivers influencing the implementation of sustainable construction in Ghana. Structured questionnaires were formulated from identified barriers and drivers from literature. The questionnaires were undertaken via online survey through google forms and sent through emails to respondents. All the 93 architectural firms registered with the Architects Registration Council (ARC) were included in the survey to accommodate the problem of low rate of responses from architects in surveys. In all, 71 responses were received, 68 (73.11%) were considered responsive for the analysis due to inconsistencies or incompletion. Relative Importance Index (RII) was used to analyse and rank the data collected. The result suggested that sustainable construction implementation is at its infancy stage. The majority of respondents believe that client demand is the key driver whereas the key barrier is lack of financial incentives. Change in legislation, tax incentives and awareness creation were the most influential factors that can promote the drivers and at the same time mitigate or eliminate the barriers. It was also suggested that the uptake of Building Information Modelling (BIM) by professionals in the industry will help in the promotion and implementation.

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Make a joyful noise to the Lord all ye land. Serve Him with gladness and come into His presence with singing and thanksgiving!

I thank the Lord God for seeing me through to this level of education, the opportunities and abilities He has given me to this day: great is His faithfulness.

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CHAPTER ONE

INTRODUTION

1.1 BACKGROUND OF STUDY

In recent times, researchers and practitioners in almost all disciplines have become conscious of the need to conserve natural resources (de Albuquerque, 2016). Rapid urbanization and industrialization have resulted in over exploitation and unsustainable consumption of the earth's natural resources. This phenomenon has resulted in environmental degradation, low economic profitability, water, air and land pollution, destruction of biodiversity, and generation of tons of waste among others. The need to reverse this trend and promote practices that seek to maintain the earth resources so as to sustain the human race (both the present generation and future generations) has become imperative. This has given birth to the concept of "sustainability". The World Commission on Environment and Development (WCED) propagated this concept in 1987 (Brundtland, 1987). The document defined sustainability as meeting the needs of the present without compromising the prospects of the future (Brundtland, 1987). Particularly, issues regarding sustainability are more crucial in the construction industry because they consume majority of the Earth's natural resources (Pitt et al., 2009; Jones et al., 2010).

According to Son et al. (2011), construction all over the globe accounts for 40% of total energy consumption, 40% of all raw materials, 25% of all timber and 16% of water consumption and 35% of CO_2 emissions. These figures appear alarming and thus there is no doubt the impact of the construction industry on the environment is massive and adverse. As a result there is the need for the construction industry to adopt sustainable innovations in terms of products and processes to be able to meet its environmental responsibilities (Agyekum - Mensah et al., 2011). Although awareness and

implementation of sustainable concepts continue to grow in industrialized countries, the same cannot be said for the under developed and developing countries (Ahmed et al., 2014). Whiles there is a significant level of awareness of this concept in the construction industry, its implementation cannot be seen or has not manifested yet (Araújo, 2013).

This study therefore seek to pinpoint the key drivers and barriers affecting the translation of the level of awareness in sustainable construction in to practice, from the Architects perspective. It also aims at determining measures that can be done to remove or mitigate these barriers impeding sustainable construction practices; and ways to enhance the drivers that promote sustainable construction practices, to ensure accelerated implementation of sustainable construction in Ghana.

1.2 PROBLEM STATEMENT

The Government of Ghana together with non-governmental bodies, academia and individuals, through the promulgation of laws, regulations and policies, are vigorously propagating sustainability awareness to promote their business interest as well as safeguarding the environment (Atongo, 2014). According to Ahmed et al., (2014), the problem is more of the desire or courage and strategy to implement sustainable construction practices and less of awareness. Hence, one can argue that stakeholders in the construction industry are aware of the devastating nature of traditional construction practices as against the benefits of sustainable construction. So far, observation and research demonstrates that the concept of sustainability is not practiced extensively in the country (Bangdome-Dery, & Kootin-Sanwu, 2013). This situation is not peculiar to Ghana because research has proven that in Malaysia, the construction industry is still not implementing the concept of sustainability and sustainable construction despite the

high level of awareness among practitioners (Zainul,2010). Perhaps, this is so because researchers have not provided a practical means of dealing with the factors that affect the implementation of sustainable construction.

Architects, compared to other professionals in the building industry, have greater influence on sustainable construction as they have the opportunity to educate and inform the client at an initial stage of the project (Pitt et al., 2009; Wyatt et al.,2000), especially in the traditional method of procuring a building which is the most popular means of procuring a project in sub Saharan Africa (Rwelamila,2016).

The National Building Regulations, (1996), LI 1630, stipulates that "a building or group of buildings with an aggregate floor area in excess of 120 square meters and of twostoreys and above in height in an urban or metropolitan area shall be designed only by an architect in consultation with allied professionals". The above argument places the architect at a crucial position in the construction industry. The involvement of the Architect on construction projects span from the design stage throughout the construction period to the end of the defect liability period. They are also involved in facility management and renovations making them have a full overview of factors that affect the entire life cycle of a construction project. Most Contractors even admit that architects and clients are the most important players in sustainable development (Zainul,2010). Due to the low level of sustainable construction implementation and the pivotal role Architects play in the construction industry in Ghana, this research was designed with the principal aim to explore and analyse the barriers and drivers that affect the implementation of sustainable construction practices in the Ghanaian building industry from the architects perspective.

Considering the above discussions, the following research questions were formulated:

i. What is the perceived level of implementation of sustainable construction in Ghana? ii. What are the key barriers to implementation of sustainable construction in Ghana?

iii. What are the key drivers facilitating the implementation of sustainable construction in Ghana?

iv. What measures can be done to enhance the drivers or mitigate the effects of the key barriers of implementation

1.3 RESEARCH AIM AND OBJECTIVES

1.3.1 Aim

This research aims at establishing a practical way of translating the level of sustainable construction awareness in Ghana into its actual implementation.

1.3.2 Objectives

The research objectives of this study were to:

- Identify the perception of Ghanaian architect's on the level of implementation of sustainable construction practices in Ghana
- Identify key drivers and barriers to the implementation of sustainable construction practices in Ghana from the Ghanaian Architect's perspective
- Prioritise the identified drivers and barriers with respect to implementation of sustainable construction practices in Ghana
- Identify key measures that can be undertaken to enhance the drivers or mitigate the effects of the key barriers of sustainable construction implementation in Ghana.

1.4 SCOPE

The research is limited to Architectural firms certified by the Architects Registration Council (ARC) to practice architecture in Ghana and members of the Ghana Institute of Architects (GIA). This is to ensure that architectural draughtsmen, building technicians and other practitioners of the industry who have no training in architecture but have illegally confer on themselves the title of an architect are not captured in the survey. Since the survey was going to be conducted online, all architectural firms and architects who meet the above criteria, no matter their geographical location, were included in the survey. The survey is again not limited to any number of years of practice.

1.5 SIGNIFICANCE

The outcome of this research will make two key contributions to the construction industry in addition to some peripheral findings that will be identified to have some level of effect on the implementation of sustainable construction practices in Ghana.

This study will explore theories, methods and practices in areas of implementation of sustainable construction practices in the construction industry in general, actions that can be taken to eliminate or mitigate the barriers to implementation whiles enhancing the drivers. Thus it is expected that at the end of this study, researchers and practitioners in the construction industry will better understand the key issues that have to be considered to promote the implementation of sustainable construction concepts in Ghana and globally as a whole. In addition, it will aid in establishing the factors that influence the promotion, adoption, implementation and enhancement of sustainable practices in the Ghanaian construction industry.

In terms of practice, the study is expected to provide a guide that can facilitate the development of a construction sustainability framework or policy for Ghana. In addition, practitioners in the built environment can use the findings as a guide, to help them better understand the advantages and disadvantages of adopting and applying sustainable construction concepts. They will also be more capable of evaluating their current state regarding adoption and implementation of sustainable construction methods and its application.

1.6 RESEARCH METHODOLOGY

The study targeted architectural firms registered with the Architects Registration Council to practice architecture in Ghana. To cater for the problem of low responses from architects in surveys, the census survey technique was adopted to obtain a true representation of the population. The positivist research approach was used, thus quantitative methods were employed in the study. Structured questionnaires, prepared from literature, were distributed to all the population and the data obtained was analysed with the Relative Importance Index (RII) proposed by Adnan, (2008).

1.7 STRUCTURE OF REPORT

This was presented in five main chapters. **Chapter One** is the Introduction. This chapter seeks to prepare the reader on basics of sustainability and also present a brief justification for the study. Hence, it comprises the background of the research, problem and the specific justification of the study, the aim and objectives, the limitations and expected contribution of the study.

Chapter Two presents the literature review. In this chapter, brief history and development of the concept of sustainability, problems posed by traditional

construction practices, sustainability assessment procedures and methods, barriers to adoption of sustainable construction, current state of sustainability in Ghana and a review of sustainable construction practices. In addition, the chapter provides arguments on the need for the study and attempts to establish how existing literature supports the study.

Chapter Three is on the research approach that was adopted for the study. It describes the population, the sample and the data collection techniques that was used. Also, the chapter presents arguments that justify the research objectives under investigation.

Chapter Four focuses on the findings, analysis and Discussion. Here findings of the study will be presented and the discussions will aim at explaining the theoretical and practical implications of the findings.

Chapter Five concludes the thesis and provide recommendations and limitations of the study. Based on the limitations and research implications, future research areas that need further investigations will be proposed. The research will also be conducted within three months duration. Thus due to time constraints some activities may be adversely affected. For instance, the amount of time that will be allocated to data collection may not be adequate to collect enough information. However, statistical methods would be applied appropriately to address these limitations.

CHAPTER TWO

LITERATURE REVIEW

2.1 INTRODUCTION

This chapter addresses the first objective of the study by discussing the main concepts of sustainability with regards to the construction industry. It starts with definitions of key terms and continues with a brief history of how sustainability in the construction industry has evolved. In addition, current literature on sustainability principles and methods adopted by the Ghanaian construction industry is also discussed vis a vis how the developed countries are practising it. It also provides a justification for the study. The key barriers and drivers that affect the implementation are also discussed.

2.2 EVOLUTION OF SUSTAINABILITY

With growing concern in the late 1960s about the devastating effect of development on the environment, the United Nations (UN) General Assembly convened the 1972 Stockholm Conference on the Human Environment held at Stockholm. This was the first taking stock of global human impact on the environment; an attempt that aimed to establish the fundamentals of how to deal with the challenge of preserving and enhancing the human environment. This Declaration served as a practical approach that encouraged and also provided a platform for the protection and improvement of human environment. In addition, it addressed and presented the existing impairment (Wright, 2002). Consequently the formation of the United Nations Environmental Programme (UNEP) which is currently based in Nairobi, Kenya. (UNEP Report of the Governing Council, 2003).

The first meeting of the UNEP resulted in the formulation of the term "ecodevelopment" as a way of verbally reconciling the desire for development and environmental protection. After this, global awareness of environmental issues increased. However, this awareness was faced with a bigger challenge where leaders of

some developing countries complained about how attention has been given to the environment in times where famine and hunger continues to be a major challenge. Amidst these opposing ideas, the World Council of Churches (WCC) explained that issues regarding climate changes and its effects, affect both the impoverished and vulnerable communities of the globe (Robra, 2005).

In the 1980s the International Union for the Conservation of Nature through its World Conservation Strategy promoted the idea of Sustainable Development. This was followed by the UN's commissioning of the World Commission on Environment and Development in 1982 chaired by the then Prime minister of Norway, Gro Harlem Brundtland. This commission was known as Brundtland's commission, and presented "Our Common Future" report that made the concept of sustainable development widely promulgated. The report was followed by the "Earth Summit" in Rio de Janeiro in 1992 and the 2002 World summit of sustainable development in Johannesburg, South Africa (Drexhage & Murphy, 2012). The South African conference marked a further expansion on the standard definition that resulted in the widely used dimensions of sustainable development. These dimension are discussed in the next section.

2.3 THE CONCEPT OF SUSTAINABILITY

After four decade of coming in to being "Sustainability" is still at an embryonic stage of development making it open and flexible. It is adaptable to every sphere of human society and natural ecosystem. This versatility has generated numerous, diverse interpretations and definitions by many scholars and practitioners. This has caused a seemingly ambiguity in its meaning. Therefore, researchers still do not have a clear definition of the term. However, some key words keep on resonating in most definition.

These words are “environmental and development” and mostly seek to promote the aim of maintaining the earth and human race as well as improving the economy (Agyekum-Mensah et al., 2011). According to Ofori, (1998) sustainability can be considered as the extent to which a natural resource can be exploited or used without adversely affecting its existences. The Bruntland Commission also defined it as how the needs of the present can be met without compromising the future (Moran et al., 2008) .

The concept of sustainability postulates that resources of our planet are limited, and humanity must not take no more from nature than it can replenish (Robinson, 1993). This is to enable us preserve the basic life support system on the planet for future generations. Undoubtedly, meeting the needs of the future generation depends on how the balance between social, economic and environmental needs is managed presently. Hence there is the need for a concerted effort towards such a goal (Wackernagel & Rees., 1998). More importantly, the concept of sustainability does not seek to promote absolute limits, rather discusses the limitations that existing technological advancement and social organizations are presenting to our natural environment (Adger et al., 2009;Ekins, 1993). In effect, it aims at preserving the basic life support system on Earth by advocating for a richer quality of life and a stronger connection between humans and nature.

2.4 DIMENSION OF SUSTAINABILITY

Sustainability thrives on three main dimensions namely: environmental responsibility; Social awareness and Economic profitability (Plymouth, 2010). These dimensions are not independent of one another but rather interrelated and intertwined. Achieving the right balance between these dimensions supports true sustainability (Construction

Industry Research Information Association - CIRIA, 2006) that creates and maintains conditions for humans and nature to exist in productive harmony.

Accordingly, there is a need to create a balance between these three dimensions. Figure 2-1 is a diagrammatical explanation of the three dimensions of sustainability.

2.4.1 Principles of Sustainability

Existing research demonstrates that scholars in the area of sustainability have different opinion regarding sustainable principles. Some have argued that there are six main

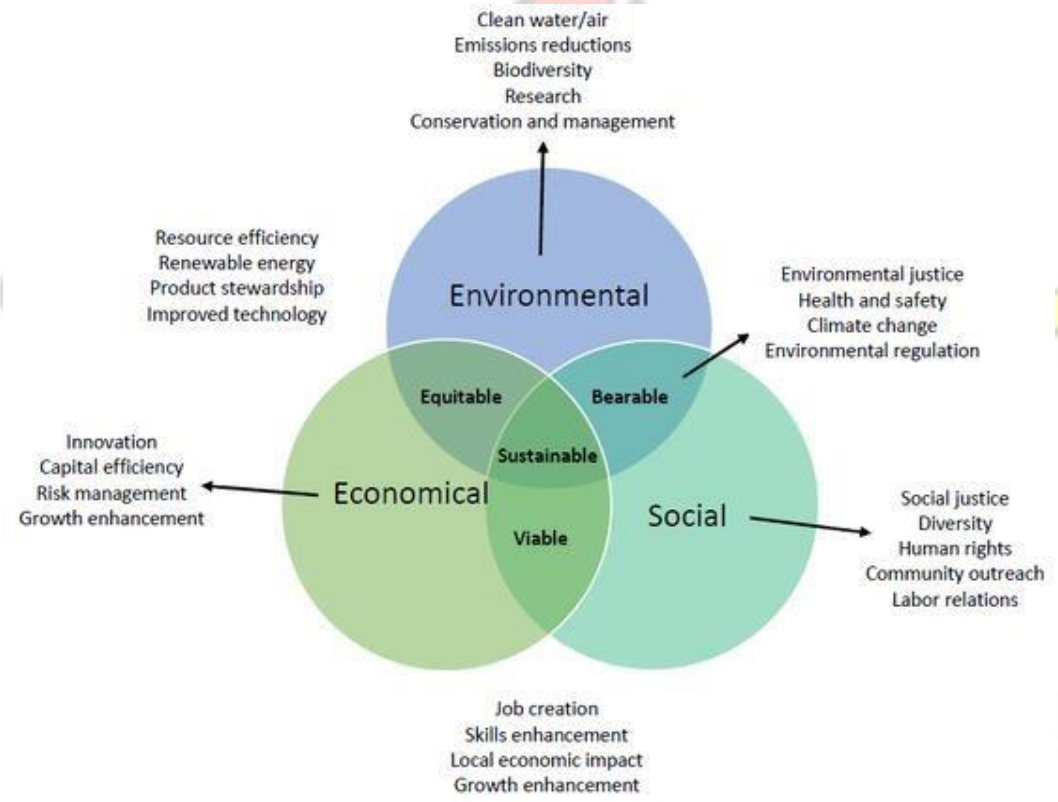

Figure 2.1 The Sustainability Venn Diagram (Ulrich, 2015)

principles (Lindenmayer & Cunningham, 2013). These are minimization of resource consumption, maximization of resource reuse, use of renewable and recyclable resources, protection of the natural environment, creation of a healthy and a non-toxic environment and the pursuance of quality in the creation of the built environment.

Others have argued otherwise. These principles apply to the entire life cycle of the built environment, “from cradle to grave” including all resources needed to create and operate a building. This comprises of proper land use and site planning, materials, water and energy efficiency, and preservation of the local ecology and culture (Kibert, 2008), all these are interwoven and symbiotic and must be tackled holistically.

2.5 SUSTAINABLE CONSTRUCTION

Bourdeau (1999) defined sustainable construction as the responsible management of a healthy built environment that considers prudent and efficient use of our resources based on ecological principles. UNDESA (2010) also defines it as “Construction that generates the least undesirable consequences on the biosphere while promoting economic, social and cultural improvement at local, regional and global level and still fulfilling the required performance”. Others have defined it as an activity which in its own processes and products aims to minimize energy usage and harmful emissions whilst producing relevant information for its customers for their decision making (Kibert, 2008).The term which was proposed by Hill and Bowen (1997) aimed at describing the responsibility of the construction sector in the attainment of sustainability. Thus it included issues regarding site planning and organization, the use of recycled materials, efficient conservation of energy and natural resources, and preservation of the environment among others (Ihuah et al., 2014; Berardi, 2012). In particular, the primary focus was on issues of inadequate resources specifically regarding energy. Here the advocators were more concern about the need to manage energy use during construction (Evans et al., 2009; Ortiz et al., 2009).

However, with time the attention moved to the need to reduce the impact of construction on the natural environment and further to encompass social and economic issues as

well. In this paper, sustainable construction refers to construction industries' adoption and implementation of the principles of sustainable development in project execution by striking a balance between environmental protection, social well-being and economic prosperity for the benefits of both the present and future generations

2.6 THE ROLE OF ARCHITECTS IN THE CONSTRUCTION INDUSTRY

The National Building Regulations, 1996, LI 1630, stipulates that a building or group of buildings with an aggregate floor area in excess of 120 square meters and of two storeys and above in height shall be designed by an architect. All buildings in an urban or metropolitan area shall also be designed only by an architect in consultation with allied professionals. Observation from Hubbard, (1995) as cited in Oyedele et al., (2010) indicate that the architect goes through an iterative process with lots of out of sequential changes happening to the design from inception through construction to commissioning. For each project the architect goes through seven key stages comprising appraisal and feasibility studies, design brief, conceptual and design development, technical design and production information, tender documentation and tender action, mobilization and construction to practical completion and post practical completion which includes rectification period, adjustment of contract sum, issuance of final certificate and review of project performance in use (Chappell and Willis, 2010). This puts the architect at the centre of the construction process.

2.7 THE ARCHITECT AND SUSTAINABLE CONSTRUCTION

Design has a key role to play in sustainability, Wyatt et al., (2000). Aside from Architects' primary responsibility to their clients, in the United Kingdom, the code of conduct for Architects by the Architects Registration Board (ARB) mandates architects to have greater concern for the safety of the general public in addition to protection for

the environment and natural resources (Pitt et al., 2009). Architects are trained to be able to conceptualize the client's brief and understand the intricate construction processes to ensure successful completion of the project. Failure by the architect will inevitably lead to problems and a high probability of project failure. Hence the performance of the architect is critical to the success of construction project

(Hartkopf et al., 1986). The concept of Project managers is at an infancy level in the construction industry in Ghana, (Agyekum-Mensah et al., 2011) therefore architects are predominantly still in charge of projects as designers and managers from inception to commissioning (Wahab, 1988; Adams, 1995).

Some architects are also involved in facility management and renovations making them have a full overview of factors that affect the building through the entire life cycle of the building. The architect thus has a high responsibility of ensuring high level of performance and delivery. Architects, compared to other professionals in the building industry, have great influence on the construction processes and for that matter sustainable construction as they have the opportunity to inform and influence the client at an initial stage of the project (Pitt et al. 2009;Wyatt et al.,2000), especially in the traditional method of procuring a building which is the most popular means of procuring a building and other construction project in sub Saharan Africa (Rwelamila,2016). Most Contractors easily admit Architects and clients as the most important players in sustainable development (Zainul,2010).

2.8 IMPACT OF SUSTAINABLE CONSTRUCTION

2.8.1 Environmental Impact

The construction industry has come to terms on the broader environmental and social agenda that seeks to present sustainable construction as a key concept to resolving the

menace posed by construction. This is because the built environment affects our daily human activities. The construction industry represents over 50% of the national capital in most countries. In some cases they make up 10% of GNP (Bash, 2015). Globally it accounts for almost 10% of the world's Gross Domestic Product, (GDP) leading to the creation of about 7% of jobs.

Thus its contribution to a nation's socioeconomic development cannot be overruled. In this sense, it provides significant opportunities for employment and also infrastructure and facilities needed. These facilities include schools, factories, residential accommodation, and hospitals among others.

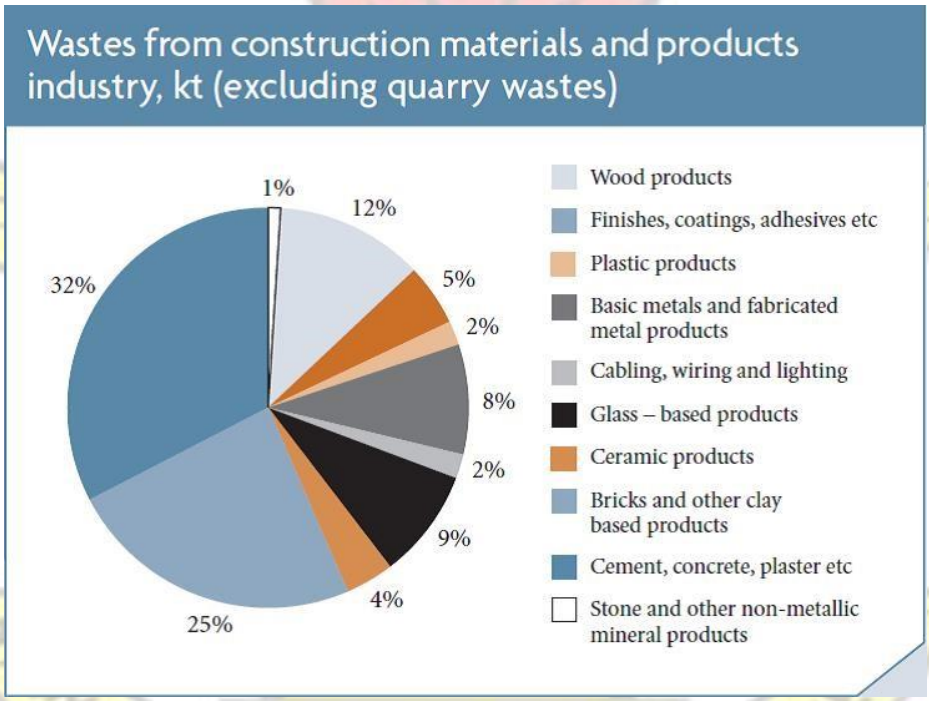

Figure 2.2 Waste from Construction Materials (Eales, 2012)

This leads to a huge demand on the environment and natural resources. For instance cement production, which is core to the construction industry, leads to enormous amount of CO_2 emission. It is estimated that the production of a ton of cement leads the release of almost one ton of CO_2. This situation is more alarming in the industrialized

countries. In the US alone buildings consume 38.9% of energy, 38% of CO2 emission and 30% of waste output (Chen, Okudan, & Riley, 2010). In the UK, the 40% of all waste is generated by the construction industry. They are also responsible for 50% of the total energy usage and 45% of heat, lighting and ventilations (Pitt et al., 2009).

Another material which is energy intensive in its production that is used heavily by the construction industry is steel. It is evident that the use of materials in the construction industry affects the environment during the production of these material (i.e. extraction) and during its use (construction). Some researchers have demonstrated that about half of wastes materials result from building activities.

Figure 2.3 A Cement Mill Discharges Waste Gas in Binzhou, East China's Shandong Province (Global Times 2013)

2.8.2 Economic Impact

The construction industry forms a large part of the economy of every country contributing between 5 and 10 percent of gross domestic product and employs up to 10 percent of the working population (Ofori, 2012). Construction provides the physical

infrastructure needed by all spheres of the economy (school, hospitals, residential buildings, commercial buildings among others,) to function effectively, therefore the quality of the production environment provided by the construction industry eventually impact on the economy of the nation (Djokoto et al., 2014).

Government who is the largest investor in the construction industry through the provision of infrastructure has the opportunity to use the construction industry to regulate the economy by varying the level of spending. Construction has many complex correlations with other sectors of the economy and can influence the performance of these sectors (Ofori, 2012), for instance long low demand from the construction industry for materials will eventually impact on the manufacturing industry and the economy as a whole. These factors give the industry the opportunity to become the foundation for solving developmental and sustainability challenges (Ebohon and Rwelamila, 2001). However this opportunity has been down played in Africa and a critical strategy needs to be formulated to deal with this issue (Djokoto et al., 2014).

2.8.3 Social Impact

Walker (2000) identified that sustainable construction improves resource efficiency, air quality, social sustainability (e.g. local employment) and occupant health, reduction of embodied/capital carbon, better resource security, and greater energy efficiency and these are beneficial to everyone. It helps in attracting and retaining good support staff as well as reduce absenteeism (Keeping and Shiers, 1996). It also boost the brand image of organizations (Pitt et al., 2009).

2.9 SUSTAINABILITY ASSESSMENT

Performance is considered to be the measurement of success against intent (Rush, 1986) and therefore the assessment of sustainable development is a major prerequisite for

determining the level of implementation and promotion of the sustainability construction concept (Berardi, 2012). Assessment is defined as the processes involved in the identification, prediction and evaluation of the potential impact of initiatives and alternatives (Devuyst, 2000). Although the discussion on how construction sustainability can be measured effectively appears to be faced with diverging and ambiguous concepts and approaches (Steurer & Berger, 2011), researchers do agree that all assessment methods should seek at ensuring that construction practices do not put the present and future of humankind in danger. The 1970s energy crisis initiated the need for regulations and limits for all buildings around the world. Consequently, the energy consumption evaluation instrument was developed to regulate energy consumption limits. This was considered as a sustainability measure for building assessment. However, the evolution of sustainable constructions has led to energy consumption limits being considered as only one parameter in sustainability assessment. Some researchers have argued that the complexity of buildings suggest the need for a multidisciplinary method of assessment. Buildings are not constructed by a simple assembling of raw materials. Rather it is a complex incorporations of technologies assembled in a unique fashion. Hence its assessment should consider all the various components and the integrations among the various functions (Berardi, 2012). In particular, the current accepted concept of construction sustainability as discussed earlier suggest the environment within which the building is constructed should also be included in the assessment process.

Subsequently, building sustainability assessment tools combines a number of sustainable indicators to be able to ascertain the sustainability level of a building. Szydlik (2014), identified the follow indicators as the bases for most of the sustainable building measuring tools; maximization of resource efficiency, high energy-efficient

building systems, use of renewable energy, water conservation and greywater use, use of passive architecture to enhance indoor environmental quality and usage of non-toxic, salvaged and local materials. It also includes indoor environmental quality, resilience of building materials and designs to meet local harsh climatic conditions and the ability of buildings to adapt to different uses over time.

2.10 SUSTAINABILITY ASSESSMENT TOOLS

Despite the attempt by the Sustainability Forum and other organizations to come out with a unified code for measuring sustainability, there still exist numerous and diverse tools for measuring sustainability (Pitt et al., 2009). This is as a result of the different levels of relative importance attached to the various drivers and barriers by people of different socio cultural background, resulting in most countries having their own sustainable building assessment tool. Some of the sustainable building assessment tools are Building Research Establishment Environmental Assessment MethodologyBREEAM- in the UK, Leadership in Energy and Environmental Design, (LEED) in the

USA, Sustainable Building Tools, (SB Tools), Comprehensive Assessment System for Building Environmental Efficiency (CASBEE) developed in Japan, Green Star (Australia and South Africa) and many others (Araújo, 2013).

In Ghana, the Ghana Green Building Council (GHGBC), a chapter of the World Green Building Council, was established with the aim of orienting the built environment in Ghana towards sustainability. This is to be achieved through planning, designing, construction, maintenance, operation and decommissioning (Kwofie, Amos-abanyie, & Botchway, 2016). Green Star Gh., the official sustainable rating system for the GHGBC, was adopted from South Africa and modified to fit local Ghana's conditions.

The rating is based on four main indicators namely; Site sensitivity and sustainability, Water efficiency, Energy efficiency, Materials efficiency and Interior environmental quality (GHGBC Official Launch Handbook, 2011). Other things that are considered are design innovation, ease of maintenance and amount of emissions.

2.11 DRIVERS AND BARRIERS OF SUSTAINABLE CONSTRUCTION

In order to be able to identify the drivers of sustainable construction in pursuance of the aim and objectives of this study, it is relevant to understand what is meant by "drivers and barriers" and for that matter "drivers and barriers of sustainable construction" in the context of this study. Even though the concept of "drivers" is often found in sustainability, there is no firm definition for the term (Bash & Häkkinen, 2015). However, it is mostly and for the purposes of this study meant to be the various elements that trigger, sustain and expand the uptake and implementation of certain activities; sustainable construction practices in this case. Drivers have positive and enabling effect. Drivers can be categorized into pull and push factors according to (Revell, Stokes, & Chen, 2010).

The "Pull" are usually the potential benefits to be accrued in terms of more jobs, good corporate image, retention of quality staff and breaking into new market, whereas "Push" are generally reactions to regulatory demands and financial incentives.

On the other hand, and for the purposes of this study, "barriers" refer to attributes and conditions that can prevent or hinder actions or impede progress towards achieving a strategic business objective (Vandierendonck, Liefooghe, & Verbruggen, 2010) i.e. the implementation of sustainable construction practices for that matter. Barriers have negative impact on the realization of the adoption and implementation of sustainable construction practices. They can be internal or external factors. Internal barriers include

(but not limited to) issues like knowledge, awareness, attitude and misconceptions towards sustainability whereas external barriers comprises issues like availability of technology, green products, finance and others resources (Hiller & Connell, 2016).

Stakeholders acknowledge the fact that implementation of sustainable construction possess both opportunities and challenges (Opoku, 2013). Although research indicate that most stakeholders in the construction industry are not following sustainable construction processes, a fair amount of attention has been given to the propagation of the, concept according to Solomon (2005). For instance, in the United Kingdom, several research works have been conducted to ascertain the drivers and barriers of sustainable construction in that jurisdiction. One of such works is by Pitt et al., (2009). Using a population of all professionals in the construction industry in the United Kingdom, i.e. architects, quantity surveyors and civil engineers, financial incentive and supporting building regulations were indicated to be the top ranked drivers. Affordability and lack of clients demand were the first and second ranked barriers, respectively. In Ghana as well, some of such research works have been conducted. For example, Djokoto et al. (2014), conducted a study on the barriers of sustainable construction in Ghana. According to the study, professionals in the Ghanaian construction industry ranked lack of demand and lack of a strategic plan to trigger, pursue and promote sustainable construction in Ghana as the two most important barriers to sustainable construction in Ghana.

The uptake and implementation of sustainable construction principles is either propelled or hindered by drivers or barriers respectively. Table 2.1 and Table 2.2 show some of the various barriers and drivers of sustainable construction identified from literature.

2.12 FUNDAMENTAL FACTORS OF SUSTAINABLE CONSTRUCTION

A total of 34 drivers and 42 barriers were identified through literature. These barriers and drivers identified were categorized into four basic factors; financial, knowledge based, legislative and professional/technology based factors. Below is a discussion on how these factors affect implementation of sustainable construction.

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Table 2.1 Barriers of Sustainable construction

Barriers	Research approach	Sample	Reference
• Lack of Building Codes and Regulation, • Lack of incentives, • higher investment cost, • Risk of investment, • higher final cost, • Lack of Public awareness, • Lack of Demand, • Lack of strategy for promotion • Lack of Expertise, • Lack of cooperation • Lack of database and information • Resistance to change • Lack of training • Lack of Technology, • Lack of Government support • Lack of a measurement tool	quantitative	Professionals in the Ghanaian construction industry	Djokoto et al., 2014
• Lack of Building Codes and Regulation, • Lack of incentives, • higher investment cost, • Risk of investment, • higher final cost, • Lack of Design and Construction team • Lack of Technology, • Lack of training, • Lack of cooperation	qualitative and quantitative (Mixed Method)	contractor and consultant organizations in the UK construction industry	Opoku & Ahmed, 2014

• Increased capital cost Contract requirements • Large size and diverse company activities • The perception that sustainability cost more • Managing competing and conflicting targets with other business aims • Sustainability is down on the boards priority list	quantitative	Architects in Ghana	BangdomeDery & kootin-Sanwu, 2013
• Cost considerations & Implications, • Lack of knowledge on sustainable practices, • of sustainable design practices by architects, • Attitude of Professionals, • Absence of a Rating tool to measure building sustainability, • Overall Cost of Alternative Energy Sources Overall Client Control on design	quantitative	Finland	Bash & Halkkinen, 2015

Table 2.2 Drivers of Sustainable Construction

Drivers	Research Approach	Sample	Reference
• Win more jobs • Client requirements • Green Reputation • Stakeholder influence • Attract top graduates • Competitive Advantage • Legal Requirement	qualitative and quantitative (Mixed Method)	contractor and consultant organizations in the UK construction industry	Opoku & Ahmed, 2014
• Imposition of stricter regulations • Establishment of longer customersupplier relationship • Awareness of environmental, social and economic impact • Implementation of environmental management system • push from the top management • Implementation of ISO14,000 kind of certifications	Quantitative	Construction industry professionals in India	Arif et al., 2013

• Demand by Stakeholders • Financial Benefits • Need for Corporate/Social Responsibility • Environmental sustainability	quanlitative	South African Construction Professionals	Windapo, 2014)
• Steering and regulations • Costs, risks and market value • Demand and the role of clients • Tendering and procurement processes • Process phases and scheduling of tasks • Cooperation and networking • Knowledge and common terminology • Availability of integrated methods • Innovation	Quantitative	Construction Professionals in Finland	(Bash & Häkkinen, 2015)
• Financial incentives • Building regulations • Client awareness • Client demand • Planning policy Taxes/levies • Labelling/measurement • Investment		Construction Professionals in United Kingdom	(Pitt et al., 2013)

2.12.1 Financial Factors

Although a number of campaigns have demonstrated that it is beneficial to indulge in sustainable construction, considering it ripple benefits, researchers have argued that one of the main factors that impede sustainable construction adoption and implementation is financial incentives (Williams & Dair, 2007). This is to say that in most cases stakeholders considered the initial cost, additional cost whiles laying less emphasis on the operational cost to determine whether a project is sustainably viable. (Bangdome-Dery and Kootin-Sanwu, 2013). Some scholars have argued that sustainable

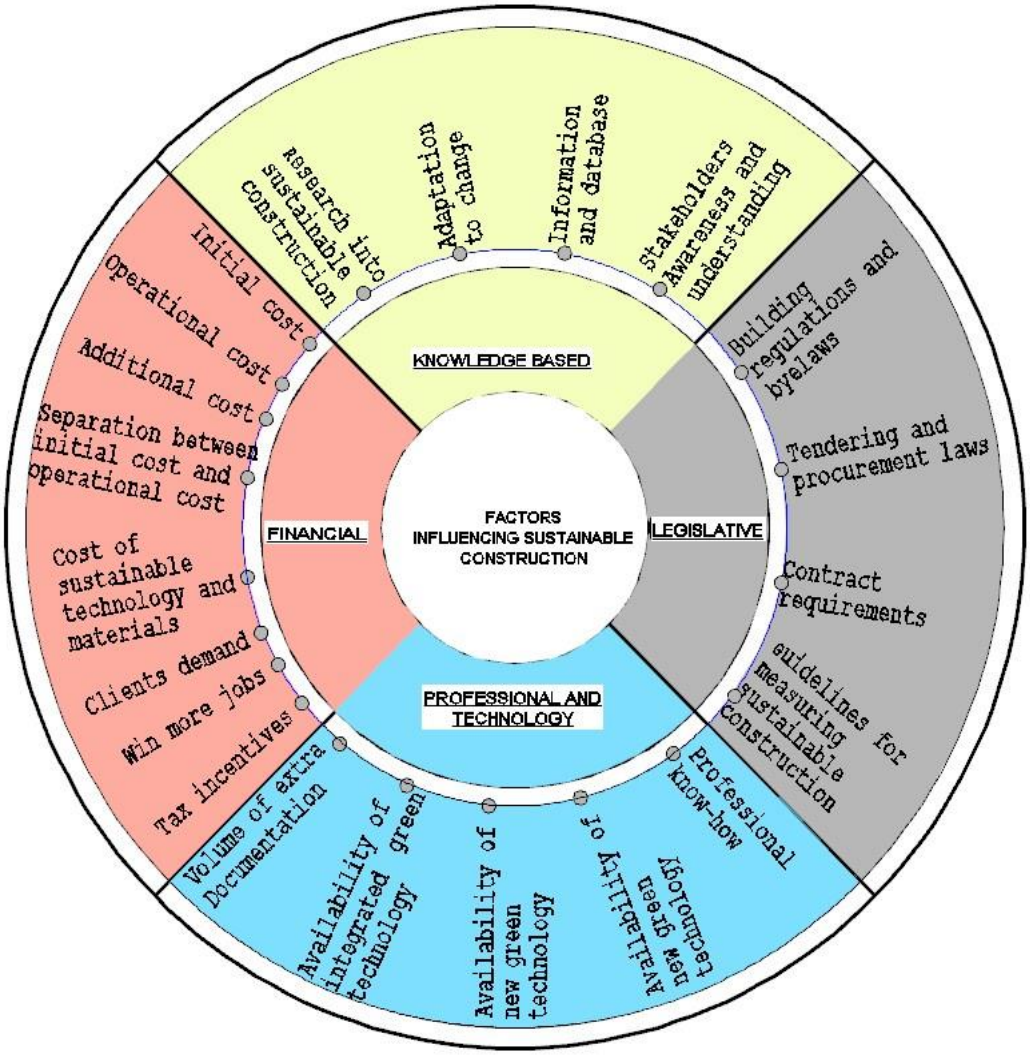

Figure 2.3 Fundamental Factors Affecting implementation of sustainable construction

construction increases construction cost to about 10% (Robichaud & Anantatmula, 2010). This therefore hinders adoptions since clients are concerned about the construction risk and cost. Others have also argued that costing of sustainable construction projects are mostly overestimated whereas the potential savings are underestimated (Yates, 2001; Zhou and Lowe, 2003; Al- Yami, and Price, 2006). In some cases the higher cost is associated with the increase in consultancy fees since the consultants are not familiar with the design and application of sustainable building

practices. This presumes that client's perception on cost and affordability impacts their demand for the sustainable buildings. (Bangdome-Dery and Kootin-Sanwu, 2013).

In some instances, it has been identified that most clients do not considered sustainable measures as part of their needs and requirements (Williams & Dair, 2007). Therefore, the extra initial cost associated with sustainable buildings deters them when they identify that conventional buildings are cheaper to construct (Robichaud & Anantatmula, 2010).

2.12.2 Legislative Factors

A key factor that is facilitating the rate of adoption and implementation of sustainable construction practices is the systematic imposition of legal regulations that ensure that practitioners follow best practices. Existing policies and regulations may promote or impede the rate at which stakeholders implement sustainable construction. This is because in some cases sustainable construction measures are not allowed by regulators (Williams & Dair, 2007). In a study, Fuss et al. (2009) established that the enactment and constancy of climate change policies affects implementation of sustainable practices. Thus less frequent fluctuations in policies increase adherence. Also some countries threat policies on sustainability as a voluntary task for local authorities and consequently does not seek to enforce sustainability with stringent measures.

In some jurisdiction, existing policies, laws, and regulations that seek to coerce or encourage clients and practitioners to implement sustainable construction, drives the increase in attention to sustainability (Steurer & Hametner, 2013; Tomas Hellström, 2007) and more governmental agencies are ensuring that sustainable designs and construction practices are incorporated into new buildings.

2.12.3 Knowledge Based Factors

Another key factor that has been identified to facilitate adherence to sustainable construction practice is sustainability awareness. It is essential that stakeholders and the general public are made aware of the environmental degradation being caused during the production of construction materials, the harmful impact of traditional construction activities on environment as well as the high maintenance and operational cost of traditional buildings. This calls for all stakeholders in the build environment to get actively involve if the implementation is to succeed. Persuasive campaigns and education must be intensified to ensure that clients and practitioners are aware of the effects of their activities. It is imperative to acknowledge that the lack of concrete understanding of sustainable concepts will adversely affect sustainability campaigns. Practitioners will not be in the position to deliver the requisite or appreciable levels of sustainable construction practices before, during and after the construction phase. Some scholars explain that efforts on impact mitigations continues to increase whiles more efforts are made to avoid the effects of construction activities as awareness of the damaging impacts of construction increases. As such advocacy and consensus for the need for appropriate strategies and actions for more sustainable construction activities is on the increase (Djokoto et al., 2014).

Sustainable construction seeks to create a built environment that is healthier. Thus it is surprising that clients demand for sustainable structures is not encouraging. It's important to note that if architects and other stakeholders propose sustainable ideas, they cannot materialize unless clients appreciate the need for such buildings, hence the need to increase awareness and make readily available the benefits of sustainable construction to the general public.

2.12.4 Professional and Technology based Factors

One of the most crucial factors to sustainable construction is the lack of capacity of the construction sector. In other words, does the construction sector have the capacity to actually implement sustainable practices? It has been established that sustainable construction practices are stalled by ignorance and lack of common understanding. Practitioners' confidence on their knowledge on construction is high, however this confidence drops whenever they are faced with issues of sustainable construction. Thus professionals within the construction industry appear not to be fully abreast with the totality of sustainable construction concepts. In addition sustainable technologies and materials requires newer competence levels that may be beyond the expertise of those in the industry (Djokoto et al., 2009).That notwithstanding, there is a possibility that this situation may not be the reality but rather a perception. Sustainable construction is a relatively new concept and thus professionals may not be confident or aware of how knowledgeable they are. Thus their perception on their capacity can lead to their slacking approach to its adoption and implementation.

2.13 SUSTAINABLE CONSTRUCTION IN GHANA

Many developing countries need massive infrastructural development (Du Plessis, 2007). Ghana, a developing country, is estimated to have a housing deficit of 1.7 million units (Ansah, 2014). This housing demand together with other developmental projects such as schools, hospitals, factories etc. will impacts on the number of construction projects in the country.

Even though Ghana is aware of the Agenda 21 for Sustainable Construction in Developing Countries, which helps to mitigate the negative impact of construction on the environment whiles maximizing the economic and social benefit, the concept of

sustainable construction is still not being implemented on a large scale in Ghana. (Du Plessis, 2007;Djokoto et al., 2014). There are numerous reasons for the low levels of uptake of sustainable construction in Ghana. Key amongst them is that the construction industry in Ghana is very conservative. It is stack to the traditional sandcrete block, mortar, concrete and mild steel reinforcement system of construction.

This has resulted in a lack of innovation in construction technologies and the search for locally sustainable construction materials. This coupled with the fact that there are no stringent laws and regulations to drive the sustainability agenda.

Figure 2.4 The Stanbic Heights Building (RMB Global Markets, 2015) Again, Ghana as a developing country is faced with investment challenge, stakeholders especially clients are not willing to pay for the initial cost along with the additional cost that sustainable construction will bring despite the long term benefits.

Other factors that has stalled the implementation are the non-availability of integrated sustainable construction systems, availability of green technology, lack of a clear

localized system for measuring sustainable construction (Djokoto et al., 2014). These factors have resulted in the construction of a very few green buildings in Ghana. Notable amongst these very few are the Stanbic Heights (fig 2-5), the One Air Port Square building (fig 2-6) and the United Nations Headquarters, all located in Accra. It is significant to note that all these prominent green buildings were not solely developed by local stakeholders but were done in collaboration with foreign partners.

This indicate that the construction industry in Ghana by itself is still not implementing sustainable construction.

Figure 2.5 One Air Port Square Building (Mario Cucinella, 2015)

2.14 CHAPTER SUMMARY

This chapter discussed the evolution of sustainability which was necessitated by the need for the preservation of the environment and eradication of poverty. This resulted in major conferences and reports such as the 1972 Stockholm conference on the Human

Environment and the Brundtland's commission in 1987. The concept of sustainability advocate the judicious use of the natural resources to meet the present needs in such a way not to destroy the earth's life supporting system, thereby giving the future generation the opportunity to meet their own needs.

Construction plays a pivotal role in the protection of the environment as well as improving the social and economic life people. Sustainable construction provides an appropriate means to conduct construction to ensure maximization of the potentials of construction whiles eliminating or mitigating its negative effect. To guarantee the successful implementation of sustainable construction all stakeholders, especially the general public, architects, quantity surveyors, civil engineer, manufacturers, suppliers and contractors must each play a major part in a collaborative and synchronized manner. The Ghana Green Building Council (GHGBC) has developed its own assessment tool known as the Green Star Rating Gh, based on four key indicators including site sensitivity, water efficiency, energy efficiency and interior environmental quality to help practitioners measure their uptake of sustainable construction.

Through literature review forty two (42) barriers and thirty four drivers (34) were identified. These barriers and drivers were grouped into four fundamental factors; financial factors, technology based factors, legislative factors and professional/ knowledge based factors. The final part of this chapter reviews sustainable construction in Ghana, which indicated a low patronage due to lack of supportive legislature, lack of awareness by clients and the general public as a whole resulting in low demand and financial disincentives.

CHAPTER THREE

RESEARCH METHODOLOGY

3.1 INTRODUCTION

There are six main approaches of knowing which are: knowing through tenacity, intuition, logic, empirics, authority, and science (Ratnesar & Mackenzie, 2006). However, in research the only accepted approach of demonstrating knowledge is through the scientific approach. The need to follow the scientific approach of knowing serves as a guide for other researchers to be capable of validating the study. In addition it helps in demonstrating that the research is rigorous. It also serves as a knowledge base for other studies.

Academic scholars hold diverging ideas on the appropriateness of research methods used for scientific studies in both behavioural and design science research. Although such a discussion might be interesting for our study, it goes beyond the objective of this research and thus it will not be discussed. Rather, this chapter presents the specific steps that were used in the study. Specifically, positivist research approach was adopted for the study.

3.2 RESEARCH PARADIGMS AND BELIEFS

As mentioned above, scholars continue to argue about the most appropriate method for management research. Some school of thought argue that management research should be considered as part of behavioural science whereas others think otherwise. Particularly, due to the multidisciplinary nature of research work in construction management (i.e. architecture, engineering, physics, legal, finance, etc.), it is extremely challenging to identify any specific approach that can be considered as the most appropriate. Nonetheless, it is imperative that proper justification is given for the selection.

Research in construction management and particularly sustainable construction can be categorised into two main types: positivist and interpretivist(Journal & Management, 2000) . In positivist research, reality is assumed to be objective and can be measured irrespective of the instrument used (Avison & Elliot., 2006). In most cases such types of studies deals with evidence of hypothesis. Dependant and independent variables are used to test formulated propositions and inferences and conclusions are drawn. On the other hand, interpretive research are mostly subjective because they assume that knowledge is shaped by its social context. It is believed that knowledge can be obtained through social construction (Avison & Elliot., 2006). In this study the positivist approach was adopted.

3.3 POPULATION

Although the study seek to investigate all professional architects in Ghana, it focused on architectural firms certified by the Architect Registration Council and architects who are members of the Ghana Institute of Architect. As mentioned earlier, this is to avoid unqualified persons, who are posturing as architect, from being captured in the survey. As of the time of collecting data, the list of registered architectural firms sums up to 93. In order to have a true representation of the population, questionnaires were distributed to all the 93 firms to accommodate the problem of low rate of responses from architects in surveys. This indicates that the census survey technique was employed.

A list of architectural firms and architects with their contacts were obtained from the Architects Registration Council and Ghana Institute of Architects respectively.

From the lists, architects who were known to the author from each of the various architectural firms were selected. The selected architects were contacted by telephone

and through social media to assist in the survey. They were also requested to recommend architects from other firms where the author was not familiar with any architect in those particular firms.

Structured questionnaires were prepared online (google forms) and administered through emails to respondents. Four of the questionnaires were not delivered to the addresses and were returned to sender. Five were also delivered as spam and messages were sent to the author's in box to contact the respondents to add him to their addresses. It was difficult soliciting responses from the architects as confirmed by Addy and Adinyira (2014) and had to follow up with several telephone calls. A total of 71 responses were received and analysed.

3.4 DATA COLLECTION

As already mentioned, a positivist approach was used and thus quantitative methods were used. It has been argued that quantitative research is a common research approach adopted in social sciences (Sekaran et al., 2001) to achieve the research objectives. Initially, literature was reviewed (see chapter two) to identify the main drivers and barriers of sustainable construction (Tables 2.1 and 2.2). The barriers identified from literature were used to develop a structured questionnaire. As recommended by Naoum (2007) the questionnaire was piloted on five (5) architects to establish the relevance and appropriateness of the questions. In addition, this was to help alleviate any inconsistencies in the questions. After two days of pretesting, some of the questions were amended to reflect the views collected from the pre-test respondents. This led to the questionnaire structured into three main sections.

The first section, examined the respondents' back ground such as position in organization, years of practice and involvement in sustainable construction projects.

These questions were included to assess each respondent's involvement in the construction industry and more specifically in sustainable construction.

The second part presented the identified barriers and drivers to sustainable construction and respondents were asked to rate the extent to which each of the barriers and drivers affects sustainable construction using a 5-point Likert scale. Here respondents were asked to indicate their degree of agreement with the barriers on the Likert scale of 5 = strongly agree, 4 = agree, 3 = fairly agree (average), 2 = disagree, 1 = strongly disagree.

The third part of the questionnaire asked respondent to rank the various drivers and barriers under each of the four main categories (financial, legislative, knowledge and professional/ technology) on a 5-point Likert scale. Responses were collected over a period of three weeks and as already mentioned there were many instances that called for the need for follow-up calls.

3.5 METHOD OF DATA ANALYSIS

The Relative Importance Index (RII) proposed by Adnan et al. (2008) was adopted for the analysis. According to Adnan et al. (2008) RII is computed by summing the frequency of responses per each value on the Likert scale by the value assigned to the scale divided by the product of the maximum value on the scale by the sum of the scale values.

RII $= \frac{\sum_{\alpha=1}^{m} \alpha n_\alpha}{m \sum_{\alpha=1}^{m} n_\alpha}$, where

m is the maximum value in the Likert scale

n_α is the n^{th} value of the Likert scale for $\alpha = \{1, 2,3, \ldots m\}$

As mentioned above, in this study, the Likert scale adopted for used a values ranging from 1 to 5. Thus the formula used for the ranking is as follows:

RII $= \frac{\sum_{\alpha=1}^{5} \alpha n_\alpha}{5 \sum_{\alpha=1}^{5} n_\alpha}$

$= \frac{5n_5+4n_4+3n_3+2n_2+n_1}{5(n_5+n_4+n_3+n_2+n_1)}$ Where:

n_5 = Number of respondents who responded strongly significant

n_4 = Number of respondents who responded very significant

n_3 = Number of respondents who responded neither significant nor unimportant significant

n_2= Number of respondents who responded moderately significant

n_1 = Number of respondents who responded not significant

3.6 CHAPTER SUMMARY

This section presented a discussion on how the research study was design. It elaborated on how the study adopted a positivist approach. The study sample targeted the entire registered architectural firms in Ghana, however, responses were collected from 71 out of the 93 registered firms. In the next section, we discuss the analysis and findings of the study.

CHAPTER FOUR

FINDINGS AND DISCUSSIONS

4.1 INTRODUCTION

This section reports the analysis and findings of the data collected. As already mentioned quantitative methods were used. It starts with a discussion on the characteristics of the respondents followed by a detail analysis of the various factors that were discussed in the previous sections (see chapter two). Specifically, it aims at addressing objectives one, three and four as stated in chapter one.

4.2 RESPONDENTS CHARACTERISTICS

Out of the total of 93 questionnaires distributed electronically, 71 responses were received. This forms approximately 76% of the total distribution. However due to inconsistency in responses and missing values in responses, 3 of the responses were discarded. Thus 68 (73.11%) observations were used for the analysis.

The respondents who answered the questionnaires were mainly architects of variable positions such as: architects, senior architects, principal architects and others. 35. 29% of the respondents were architects, senior architect were 36.29%, principal architects were 17.65% and 11.76% were in other categories that was not specified. Majority of the organizations have permanent employees between 5 and 10, forming 64.70% of the entire responses. Those with staff population above 30 formed 17.65% of responses whereas 11.76% of the responses have employees between 11 and 20. Only 5.88 % of the organizations have employees between 21 and 30. None of them has employees less than 5. See Table 4.1for details.

In terms of the years of establishment, it was observed that majority of the architectural organizations sampled, 82.32%, has operated for less than 10 years. 11.76% of the firms were recorded to have operated for over 20 years, whereas 5.88% were between the ages of 11 to 20. See Table 4.1.

Table 4.1 Respondents Characteristics

Variables	Value	Frequency	Percentages (%)
Position of respondent	Architects	24	35.29
	Senior Architects	24	35.29

	Principal Architects	12	17.65
	Other	8	11.76
Number of Employees in Organization	Below 5	0	0
	5 to 10	44	64.70
	11 to 20	8	11.76
	21 to 30	4	5.88
	Above 30	12	17.65
Organization's Age	Below 10	56	82.32
	11 to 20	4	5.88
	Above 20	8	11.76

4.3 FREQUENCY OF SUSTAINABLE CONSTRUCTION PROJECTS

To better understand patterns in sustainable construction in Ghana, data was collected regarding how often architectural firms are involved sustainable construction projects. It was observed that 23.52 of the firms studied have never been engaged in sustainable construction projects. 35.50% reported that about one out of ten of their projects uses sustainable construction concept, whilst 17.65% reported that 1 out of 25 projects uses sustainable construction methods. Again majority of those who have had sustainable construction projects have engaged in less than five of such projects. The figures

observed indicates that sustainable construction practices are not used frequently in the country.

Table 4.2 Frequency of Sustainable projects

Project Ratio	Frequency	Percent
Never	16	23.53
1 out of 10	24	35.30
1 out of 25	12	17.65
1 out of 50	4	5.88
1 out of 100	12	17.65

Majority of the projects were performed by organizations that were established between 2006 and 2016 (see table 4.3). It was observed that a total of 47.1% architectural organizations who are less than 10 years of age have performed at least one sustainable construction project. Particularly 24 out of the 56 organizations who are below 10 years have been engaged in at least 5 of such projects whereas 8 have been involved in between 6 and 10 projects. None of them had done more than 10 sustainable construction projects since establishment. . It was also observed that only firms that have less than 10 years of establishment have not engaged in sustainable construction.

This findings present the need for further investigations as to why a fewer percentage (57.14%) of the newer establishments are involved in sustainable construction practices even with the current introduction of sustainable construction practices in the curriculum of Ghanaian universities that are involved in the training of architects.

Table 4.3 Organizational Age versus Number of Projects

	Nil	1 to 5	6 to 10	Above 10	Total number of firms	% of firms engaged in Sustainable Construction
Below 10	24	24	8	0	56	57.14%
11 to 20	0	4	0	0	4	100%
Above 20	0	0	4	4	8	100%

It was recorded that all the architectural organizations who are above 20 years of establishment age have performed sustainable construction projects before. Out of this, 50% of them have been engaged in 6 to 10 whilst another 50% have been engaged in more than 10 sustainable construction projects. This indicates that majority of the firms who were established over 20 years ago are more involved in sustainable construction projects. See table 4.3 for a detail breakdown of the number of sustainable construction projects versus the age of organizations.

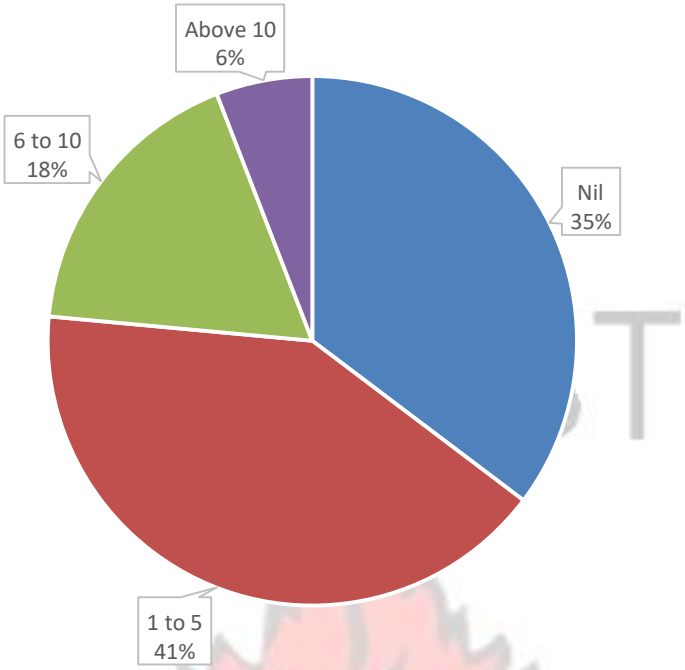

Figure 4.1 No. of Sustainable Construction Projects

4.4 PERCEPTION OF GHANAIAN ARCHITECTS ON THE LEVEL OF SUSTAINABLE CONSTRUCTION IMPLEMENTATION

Responses from all the respondent showed that the level of implementation of sustainable construction in Ghana is at its infancy level. Although this findings is a perception of the sample, yet it demonstrates that minimal attention has been given to the sustainable concepts in Ghana and the country is yet to benefit from the potentials of sustainable construction. Again, comparing this to the industrialized countries where the level of implementation is considered to advance (Ortiz et al., 2009), it calls for the need for measures to be put in place to ensure that the level of awareness is increased to ensure that more projects employed sustainable construction measures.

4.5 PREFERENCES AND FACTORS AFFECTING SUSTAINABLE

CONSTRUCTION

As stated in the research objectives of this study, one of the main issues is to identify the factors (barriers and drivers) that affect the implementation of sustainable construction practices in Ghana. As such, the various responses regarding the drivers and barriers reported by respondents were ranked in terms of their relative importance.

Table 4.4 Ranking of Drivers of Sustainable Construction

Drivers to sustainable construction implementation	Relative Importance Index	Rank
Client demand and requirements	0.79	1st
Stakeholder influence	0.71	2nd
Cost efficiency	0.69	3rd
Competitive advantage	0.68	4th
Legislative and Regulation	0.67	5th
Awareness and knowledge by top management	0.67	5th
Clear and consistent guidelines for measuring sustainable construction	0.65	7th
Win more contracts to remain in business	0.64	8th
Financial Incentives (tax rebates, high profit margin)	0.60	9th
Company's Reputation and brand image	0.59	10th
To attract and retain right staff	0.58	11th
Availability of life cycle cost analysis	0.56	12th
Moral obligation to protect the environment	0.55	13th
Investment	0.55	13th

Next is a discussion of the research findings using the various RII rankings. First ranking of drivers are discussed, followed by discussions on actions that enhances

(moderators) the drivers. Barriers of sustainable construction are also ranked and discussed, subsequently a table of ranking of the various actions that will facilitate the elimination of the identified barriers is presented. The fundamental factors of sustainable construction implementation are also discussed and details are presented on each factor.

4.6 DRIVERS OF SUSTAINABLE CONSTRUCTION IMPLEMENTATION

The major drivers of sustainable construction implementation that were identified in literature were listed on the questionnaire and respondents were asked to rank them on a scale of 1 to 5. The findings of the responds are presented in Table 4.4. It was observed that the most ranked driver by architects is client demand for sustainable buildings. This recorded a Relative Importance Index of 0.79. This disagrees with research conducted by Pitt et al. (2009), in which they claimed that financial incentives is the leading major driver for sustainable construction, see page 21.

Although their study sampled from an industrialized country (United Kingdom), as compared to Ghana, which is a developing country, the contradiction demands for further investigation. Financial incentive was recorded to be the 9th ranked in this study. Perhaps this variation can be attributed to the speculation that most Ghanaian firms do not pay the right taxes (Osei & Quartey, 2005). As it can be observed, financial incentives comprises tax rebates, high profits margins, etc. and thus in developed countries providing tax rebates alone can facilitate the demand for construction of sustainable structures. Stakeholder influence was the next to be observed as a key driver. Respondents ranking scored it an average RII of 0.71 (see Table 4.4).

4.5 Ranking of Drivers – Pitt et al. (2009) versus current study

Drivers to sustainable construction implementation	Our Study	Pitt et. al (2009)
Client demand and requirements	1st	4th
Stakeholder influence	2nd	-
Cost efficiency	3rd	-
Competitive advantage	4th	-
Legislative and Regulation	5th	2nd
Awareness and knowledge by top management	5th	3rd
Clear and consistent guidelines for measuring sustainable construction	7th	9th
Win more contracts to remain in business	8th	-
Financial Incentives (tax rebates, high profit margin)	9th	1st
Company's Reputation and brand image	10th	-
To attract and retain right staff	11th	-
Availability of life cycle cost analysis	12th	-
Moral obligation to protect the environment	13th	-
Investment	13th	7th

However this driver had not been ranked high in any of the literature available. Similarly cost efficiency recorded 3rd position. However it was not discussed by Pitt et al. (2009) or any of the literature reviewed as a major component, although researchers acknowledge that is it one of the drivers to sustainable construction. The least ranked drivers were investment and moral obligation to protect the environment with an RII value of 0.55.

Table

Although investment was recorded to be the 7th most value driver out of 9 according to Pitt et al.(2009), moral obligation to protect the environment was not one of the drivers ranked by Pitt et al.(2009).

It is worth mentioning that the low ranked valued observed for moral obligation to protect the environment is worrisome. This is particularly because practitioners in the built environment are mandated by their various codes of ethics to protect the general public and the eco-system, including flora and fauna, in their quest to satisfying their clients' interest. This therefore implies that they do not put high prominence on the environment and the necessity to protect it. Refer to Table 4.4.

4.7 ACTIONS THAT CAN ENHANCE THE DRIVERS OF SUSTAINABLE CONSTRUCTION

In order to better understand issues regarding the promotion of sustainable construction, respondents were also asked to rank key moderators of sustainable construction drivers. These moderators are activities that seek to trigger, promote and sustain the drivers.

The most ranked activity was "change in legislation, building codes and byelaws". It recorded an RII value of 0.84. This was followed by "More tax rebates/subsidies on green products" with an RII value of 0.81. Availability of new and integrated technology was ranked third with an RII value 0.76. The least ranked moderators were "Availability of Information and database" with an RII of 0.67, "Lower initial cost" with an RII of 0.66 and "funding of research into sustainable construction" with an RII value of 0.64. Refer to Table 4.6 for a detail list of activities and their respective ranking.

4.6 Moderators of Sustainable Construction Drivers

Actions that can enhance the drivers of sustainable	RII	Rank
Change in legislation, Building code and byelaws	0.84	1st
More tax rebates/subsidies on green products	0.81	2nd
Availability of new and integrated technology	0.76	3rd
Clearer means of measuring sustainable construction	0.74	4th
Stakeholders Awareness and understanding	0.73	5th
Higher investment	0.72	5th
Knowledge about the benefits of sustainable construction	0.71	7th
Education and Training of stakeholders	0.69	8th
Availability and access to green products	0.69	8th
Better advertising and awareness creation	0.68	10th
Availability of Information and database	0.67	11th
Lower initial cost	0.66	12th
Funding of research into sustainable construction	0.64	13th

4.8 BARRIERS TO THE IMPLEMENTATION OF SUSTAINABLE CONSTRUCTION

With regard to barriers that inhibit the implementation of sustainable construction practices, respondents were asked to rank 15 items on a scale of 1 to 5 with one being the least significant factor and five being the most favoured factor. The analysis revealed that "lack of financial incentives (high taxes and low profit margins)" was recorded as the first barrier to the successful implementation of sustainable construction

Table

approaches. This finding disagrees with that of (Djokoto et al., 2009). In that study it was observed that lack of demand was the key or number one barrier in the industry.

The research sampled respondents from all professionals in build environment in Ghana. Thus comparing this finding to that of Djokoto et al. (2014), it can be argued that architects in Ghana considers financial incentives as the key barrier as compared to other professionals in the construction industry. Interestingly, as already discussed, Pitt et al. (2009) argued that financial incentives are the first driver for sustainable construction. This therefore raises the argument concerning the difference between drivers and barriers. Perhaps what Pitt et al. (2009) considered as drivers can also be barriers when negated.

The lack of building codes and regulation to consciously promote sustainable construction uptake was also another factor that was considered to be very important by respondents. It recorded a value of 0.72. This is followed by lack of investment with a value of 0.69. The least rank barrier was high level of perceived risk with a value of 0.54. This is promising because it shows that architects have positive attitude towards sustainable built environment and do not perceive it as high-risk venture. In Djokoto et al.'s (2014) study, the least ranked barrier out the 10 items studied was lack of measurement tools.

Again this disparity in findings calls for further investigations on why architects perceive different barriers as more important compared to other professionals in the construction industry. Refer to Table 4.7 below for a complete ranking of barriers to sustainable construction.

4.7 Ranking of Barriers to Sustainable Construction

Barriers to sustainable construction implementation	Relative Importance Index	Rank
Lack of financial incentives (high taxes and low profit margin)	0.76	1st
Lack of building Code and Regulation	0.72	2nd
Lack of investment	0.69	3rd
Initial cost	0.68	4th
Lack of client demand	0.67	5th
High cost of environmental Services and technology	0.66	6th
Insufficient research	0.66	6th
Lack of public awareness	0.64	8th
Competitive Pressure	0.64	8th
Lack of database and information	0.62	10th
Lack of green products	0.62	10th
Lack of professional knowledge and expertise	0.60	12th
Lack of green technology	0.58	13th
Tendering and contract requirements	0.55	14th
High level of perceived risk	0.54	15th

4.9 ELIMINATION OF BARRIERS TO SUSTAINABLE CONSTRUCTION IMPLEMENTATION

Similar to discussions regarding measures that promote drivers of sustainable construction approaches, activities that promote the elimination or reduction of the

Table

effect of barriers were also analysed. Again respondents were asked to rank 13 key items identified from literature to support the elimination of barriers on a scale of 1 to 5. After the analysis, change in legislature, building codes and byelaws were observed to be the most ranked item. It recorded an RII value of 0.86.

Table 4.8 Ranking of Activities that Promotes Elimination of Barriers

What can be done to eliminate barriers	RII	Rank
Change in legislation, Building code and byelaws	0.86	1st
Better advertising and awareness creation	0.81	2nd
Tax rebates / subsidies for sustainable construction resources	0.79	3rd
Knowledge about the benefits of sustainable construction	0.79	3rd
Higher investment	0.76	5th
Education and Training of stakeholders	0.76	5th
Availability of green products	0.75	6th
Availability of Information and database	0.73	8th
Availability of new and integrated technology	0.73	8th
Clearer means of measuring sustainable construction	0.67	10th
Lower initial cost	0.66	10th
Stakeholders Awareness and understanding	0.65	12th
Funding of research into sustainable construction	0.65	12th

Remarkably, this item was also ranked 1st in activities that promote drivers of sustainable construction (see Table 4.6 above). This therefore suggests that legislature, building codes and byelaws play a key role in the promotion of sustainable construction methods. The second most ranked item was advertising and awareness creation with an RII value of 0.81.

Tax rebates and subsides was the third most ranked item with 0.79 although it was second in Table 4-6. Consequently, this suggests that tax rebates and subsides also play a very important role regarding the promotion and adoption of sustainable construction practices in Ghana. The least considered item in this regard is funding of research into sustainable constructions with an RII value of 0.65. Similarly this was the least considered activity that promotes drivers of sustainable construction in Table 4-6 where it recorded an RII value of 0.64. Refer Table 4.8 for a complete list of ranking of the activities that facilitate the elimination of barriers to sustainable construction.

4.10 FUNDAMENTAL FACTORS AFFECTING THE IMPLEMENTATION OF SUSTAINABLE CONSTRUCTION

In addition to the above specific factors discussed so far, the fundamental factors that were identified in literature regarding sustainable construction were also analysed. These factors are financial, legislative, knowledge and professional and technology based factors. Respondents ranking revealed that financial factors were observed to be the most important factor among the four. It obtained an RII value of 0.84 followed by legislative factors.

Table 4.9 Ranking of Activities that Promotes Elimination of Barriers

Primary Factors affecting the implementation	RII	Rank
Financial factors	0.84	1st
Legislative factors	0.74	2nd
Knowledge based factors	0.72	3rd
Professional and Technology based factors	0.69	4th

The second most ranked factor; legislative, recorded an RII value of 0.74 whereas knowledge base factors recorded 0.72. Professional issues was the least considered factor with an RII value of 0.69.

4.10.1 Ranking of Financial factors

To further investigate the ranking of factors, consideration was given to the different sub-types of the four main factors discussed above. Each of the sub-types was ranked using the RII.

From the analysis it was observed that under financial factors, initial cost and client demand were the most ranked with an RII value of 0.76. This again presupposes that client demand is a major contributor to the sustainable construction course, therefore awareness creation among client will very much be needed. Life cycle cost with an RII value of 0.74 came second. The least RII value observed under the financial factor was investment. See table 4-10 for a detail list of RII values observed from the study. Note that although initial cost was recorded to be one of the most ranked issues under financial factors it was not recorded as such when all factors were ranked. Rather client demand was recorded as the most ranked issue (see Table 4.4 in page 42).

Table 4.10 Ranking of Financial factors

Ranking of Financial factors	RII	Rank
Initial cost	0.76	1st
Clients demand	0.76	1st
Availability of life cycle cost analysis	0.74	3rd
Additional cost	0.72	4th
Win more jobs	0.69	5th
Tax incentives	0.68	6th
Operational cost	0.67	7th
Separation between initial cost and operational cost	0.67	7th
Cost of sustainable technology and materials	0.67	7th

This discrepancy may be a result of other factors that places emphasis on finance which may not be an issue worth considering individually but needs more attention when treated collectively under finance.

4.10.2 Ranking of Legislative factors

Respondents ranking on legislative factors also showed that the most important or most ranked legislative issue was contract requirements. Contract requirement recorded an RII values of 0.80. This therefore implies that conditions attached to the biding of construction projects, especially government projects, need to be looked at critically. Again, it can be observed that this factor (contract requirement) solely does not play a key role in general, however, it becomes relevant when considered under legislative factors. Other factors such as building regulations and byelaws were also observed to be crucial when considering legislative factors. Building regulations and byelaws

recorded a value of 0.78, whereas, tendering and procurement laws and guidelines for measuring sustainable construction were the least with a value of 0.71. See Table 4-11

Table 4.11 Ranking of legislative factors

Ranking of Legislative factors	RII	Rank
Contract requirements	0.80	1st
Building regulations and byelaws	0.78	2nd
Tendering and procurement laws	0.71	3rd
Guidelines for measuring sustainable construction	0.71	3rd

4.10.3 Ranking of Knowledge based factors

With regard to knowledge based factors, the most influential factor observed was stakeholder awareness and understanding with an RII value of 0.79. This is followed by research into sustainable construction practices with an RII value of 0.74. Adaptation to change and information and database recorded a value of 0.67 and they were the least considered factors. See table 4.12 for detail ranking of knowledge base factors.

Table 4.12 Ranking of Knowledge base factors

Knowledge based factors	RII	Rank

Stakeholders Awareness and understanding	0.79	1st
Research into sustainable construction	0.74	2nd
Information and database	0.67	3rd
Adaptation to change	0.67	3rd

4.10.4 Professional/ Technology based factors

In terms of professional and technology based factors, availability of green technology was recorded to be the most ranked RII value. Its value is 0.80. This is followed by professional know-how with an RII value of 0.78. The third most ranked RII value is availability of green materials and products with a value of 0.75. The least RII value was volume of extra documentation with a value 0.58. See table 4.13

4.11 OTHER FACTORS IDENTIFIED BY RESPONDENTS

It is significant to note that the only consistent factor that was proposed by the respondents as a driver to the implementation of sustainable construction was the use of Building Information Modelling (BIM) by the industry professionals. A total of 32.32% of the respondents suggested that BIM is a very beneficial tool that orients the design processes from a purely visualization perspective to a simulation one. This gives easy and readily available information to aid in meeting the set objectives for the project. The advantages of BIM is not limited to the design process alone but throughout the entire life cycle of the project; planning, construction, operation and maintenance, renovation and deconstruction. Other reasons given by the respondents for proposing the uptake of BIM in the construction industry is that, it ensures creativity and sustainability, improves quality, reduces human resources, cost and time.

Table 4.3 Ranking of Professional/Technology based Factor

Professional/ Technology based factors	RII	Rank
Availability of new green technology	0.80	1st
Professional know-how	0.78	2nd
Availability of green materials and products	0.75	3rd
Availability of integrated green technology	0.69	4th
Cooperation amongst professionals	0.60	5th
Volume of extra Documentation	0.58	6th

4.12 CHAPTER SUMMARY

This chapter discussed findings from analysis of data collected from the study. It started by presenting the characteristics of the respondents that answered the questionnaire. In all 68 responses were used for the analysis and the findings indicated architects in Ghana consider financial issues as the most important factor that affects the implementation of sustainable construction concepts in Ghana. Again it was observed that the most important driver was client demand whereas the most important barrier is the lack of financial incentives. Interestingly all respondents agreed that the level of implementation of sustainable construction in Ghana is at its infancy stage. They also proposed the use of Building Information Modelling (BIM) by the industry professionals.

CHAPTER FIVE

SUMMARY OF FINDINGS, CONCLUSION AND RECOMENDATIONS

5.1 INTRODUCTION

This chapter draws curtains on the entire study. It starts with a discussion on how each of the objectives were achieved and presented in the report. This is followed by a

discussion on the contributions of the study. Recommendations, limitations and future work are also discussed.

5.2 SUMMARY OF FINDINGS

5.2.1 Objective One

The first objective of the study sought to measure the perception of Ghanaian architects on the level of implementation of sustainable construction practices in Ghana. The analysis showed that all respondents perceive that sustainable construction implementation is at its infancy stage in the country. Although this is a perception, it somehow reflects the current state of the practice in the country. One can therefore argue that there is the need for more measures to be put in place to ensure that current and future construction projects adhere to sustainable practices or principles.

5.2.2 Objective Two

The identification of key drivers and barriers to the implementation of sustainable construction practices in Ghana from the Ghanaian Architect's perspective was the second objective of the study. This objective was address in chapters two. Chapter two presented the observed barriers and drivers from literature. A table was drawn to simplify the various drivers and barriers identified form literature. Although Table 2.1 and Table 2.2 provides those list that were used in this study, it is worth mentioning that it is not an exhaustive list of barriers and drivers discussed in literature by scholars. Perhaps it would have been more interesting to identify all the different types of drivers and barriers, however, ambiguity in the definitions of drivers and barriers did not permit the production of an exhaustive list.

5.2.3 Objective Three

The third objective was mainly discussed in chapter four. It started from chapter three, where the research approach and method was discussed. A questionnaire was drawn to assess how respondents rank the various drivers and a barriers. A total number of 68 responses were analysed. In all it was observed that client demand is the key driver whereas the key barrier is lack of financial incentives.

5.2.4 Objective Four

The last objectives was on the identification of key measures that can be undertaken to enhance the drivers or eliminate or mitigate the effects of the barriers of implementation in Ghana. This objective was addressed in chapter four, specifically in sub-section 4.6 and 4.9. Our findings indicated that in both situations respondents ranked change in regulation and building code and clients demand as key activities that can halt or hinder barriers from having effect and facilitate drivers of sustainable construction. Therefore it is recommended that policies are drawn by the government to create sustainable built environment awareness as well as put in place financial incentive to boost client demand. Respondents also proposed that, the uptake of Building Information Modelling (BIM) will help in the adoption and implementation of sustainable construction practices.

5.3 LIMITATION

Although the study as reported had address all the four objectives, there were some limitations of study. The study sample responses from architects in Ghana. As such the findings cannot be generalised. More importantly the sampling technique used was not probabilistic (random) thus the application of inferential statistical methods was not appropriate. Again one of the key findings of this study concluded that architects

perceive sustainable construction implementation is at its infancy stage. Although this study has substantiated an existing speculation using Ghanaian architects, the findings cannot be generalized to all professionals in the industry. It was also observed that there was limited literature on sustainable construction in Ghana. This may be as a result of the amount of attention researchers in the country have devoted to this area of study. As a result the literature review chapter failed to provide substantive information regarding sustainable methods and approaches of construction in Ghana.

5.4 CONCLUSION

Though construction has a great potential to better the lives of many people, it also consume a significant portion of the earth's renewable and non-renewable resource, leading to the destruction of the earth's biosphere. It is therefore important that construction is managed in a way to minimise resource consumption and maximise resource efficiency to derive all the benefits of construction, whereas, eliminating its devastating effect. This undoubtedly calls for the uptake and actual implementation of sustainable construction. In general, sustainable construction seeks to elimination the negative impacts of construction projects on the environment while improving the economic and the social wellbeing of people throughout the construction projects' life cycle. Despite a high level of awareness of sustainable construction practices among Ghanaian architects and other construction practitioners, its implementation in Ghana is still at an infant stage. In all it was observed that client demand is the key driver whereas the key barrier is lack of financial incentives. Change in regulation and building code and clients demand were ranked as the key measures that can halt or hinder barriers from having effect on sustainable construction implementation in Ghana. Change in regulation and building code and clients demand will at the same time facilitate drivers of sustainable construction. It is therefore important that measures

are taken to catapult the key drivers whiles eliminating the key barriers that impede the implementation of sustainable construction. It is of a strong opinion that the findings and recommendations of this study will help in the realisation of the practical implementation of sustainable construction in Ghana.

5.5 CONTRIBUTION TO KNOWLEDGE

As mentioned in chapter one this study sought to make two main contributions and at the end of the study the suggested contributions have been achieved. These are practical and theoretical contributions. Below is a discussion on the contributions made from the study. First theoretical contribution is discussed followed by practical issues.

In term of theory this study has contributed to the literature on sustainable construction in general and Ghana in particular. As it can be observed, literature regarding sustainable construction in Ghana is very limited. As such this study has provide some amount of literature on the current state of sustainable construction in Ghana. More specifically, it has provided information regarding how architects rank the various drivers and barriers backed by evidence.

Another key contribution is the measure of perception on implementation level in Ghana. To the best of our knowledge this study is the only study that has substantiated the fact that Ghana's sustainable constructions implementation is currently at its infancy stage using empirical evidence. Most of the existing claims in literature lacks empirical evidence and are mere speculations. It is therefore expected that this information will provide research with evident-based support for this claim.

It was observe that there is no distinctive difference between barriers, drivers and enablers of sustainable construction. It appears various researchers use the different

terms to mean the same thing. This therefore calls for the need for appropriate definitions that will create a better distinction.

In terms of practice, this study has provide a number of information that can guide policy formulation in Ghana. As observed from the study and mentioned earlier, most of the issues refers to financial incentives. This therefore suggest that the Government of Ghana needs to focus on issues that promotes reduction of taxes and levies, on sustainable products (recyclable materials, materials with low embodied energy, etc.)

In addition it was also observed that construction professionals do not consider protection of the environment as a key issue in sustainable construction. However protection of the environment is one of the main pillars of all professionals of the built environment in Ghana. This therefore suggests that there is a need for the government and stakeholders to focus on methods that ensures that construction professional value the environment.

5.6 RECOMMENDATIONS

5.6.1 Recommendation to Institutions

The foregoing findings are indicative of the fact that the two most influential factors affecting the implementation of sustainable construction in Ghana are finance and regulations. It is therefore imperative that supporting regulations are enacted and enforced, and also initial and running costs of sustainable construction projects are made cheaper than traditional construction projects. In this regard the following measures are recommended:

- The enactment of sustainable constructions laws by the Legislature, Metropolitan, Municipal and District Planning Authorities which will mandate all developers, irrespective of the type of development, to present a

"sustainability assessment plan" as part of requirements for the issuance of building permits. This plan should indicate the design's responsiveness to the site, water efficiency, energy efficiency, materials efficiency and interior environmental quality. It should also show the construction processes, operation processes and deconstruction processes of the project.

- Metropolitan, Municipal and District Planning Authorities should vary Building Permit processing fee in accordance with how sustainable a construction project is. The more sustainable a project is, the lower the processing fee and vice versa.
- Metropolitan, Municipal and District Planning Authorities should employ and train more building inspectors in sustainable construction principles to carry onsite inspections to ensure that developers comply with the sustainable construction laws
- Again, it should be legislated that "sustainability assessment plan" should be a compulsory requirement for all bidders of government projects.
- Government should consider the introduction of tax rebates and tax incentives for companies involved in green technology and the production of green materials. This will lure companies into the production of these materials and eventually guarantee the availability as well as lower cost of green materials and green technology.
- Lending rates by financial institutions for sustainable construction projects should be made lower than lending rates for traditional construction. However failure to implement the sustainable measure onsite should attract fines.

It is believed aside compelling developers to go for sustainable construction, these recommendations will also bring down the cost of sustainable construction lower

than the traditional construction and therefore increase client's demand for sustainable construction.

5.6.2 Recommendation for Further Research

It is recommended that further studies is conducted using larger samples and also a probabilistic (random) sampling approach to validate the findings of this study so as the results can be generalised. In addition it is also suggested that the research approach can be varied to use qualitative data rather than the quantitative method used in this case. It is expected that this will provide a richer picture on perceptions of professional in the building industry. With respect to this, it is expected that more studies need to be conducted on sustainable construction with particular emphasis on Ghana.

Lastly, although the findings in the study have provide information regarding the most ranked barriers and drivers in Ghana, there is the need for further investigations into how the various factors are related. In other sense, inferential statistical methods must be employed in future to determine whether there exist causation and correlation relationship between the various identified variables. Such an information will provide pertinent information on how to promote sustainable construction practices in Ghana. This is to say, with information on the most ranked variables any information on the relationship between the variables will provide information on which variables need to be promoted in other to trigger other variables that will lead to a speedy adoption and implementation of sustainable practices in Ghana.

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APPENDIX

KWAME NKRUMAH UNIVERSITY OF SCIENCE AND TECHNOLOGY

COLLEGE OF ART AND BUILT ENVIRONMENT

DEPARTMENT OF BUILDING TECHNOLOGY

SURVEY QUESTIONNAIRE

FACTORS AFFECTING THE IMPLEMENTATION OF SUSTAINABLE CONSTRUCTION IN GHANA: THE ARCHITECT'S PERSPECTIVE

Dear Architect,

POSTGRADUATE RESEARCH PROJECT

I am an architect (Reg. No 911) offering MSc Construction Management at KNUST and as part of requirements of the programme, I am conduction a research on the factors that affect the implementation of sustainable construction practices in Ghana; from the Architect's perspective.

I would appreciate your taking the time to complete the following survey for me. The entire questionnaire will take about 20 minutes to complete. Your responses are voluntary and will only be used for survey purposes.

All responses will be compiled together and analyzed as a group. In case you have any questions or concerns regarding the survey, please contact me on phone number: 0264677677 or email: architectwiafe@gmail.com.

Thank you very much for your time and suggestions.

Yours Truly,

Franklin Wiafe

(AGIA)

QUESTIONNAIRE

Section 1: Organization and General Information.

1. Position in organization _____

2. Number of full time employees in organization.

5-10 [ ] 11-20 [ ] 21-30 [ ] 30- 50 [ ] Above 50 [ ]

3. How long has your organization being in existence

1-10 years [ ] 11-20 years [ ] 21-30 years [ ] 30- 50 years [ ] Above 50years [ ]

4. How often is your organization involved in sustainable projects?

Never [ ] 1 out of 10 [ ] 1 out of 25 [ ] 1 out of 50 [ ] 1 out of 100 [ ]

5. How many sustainable projects has your organization been involved?

Never [ ] 1 - 5 [ ] 6 - 10 [ ] 11 - 20 [ ] Above 20 [ ]

6. How would you characterize the current state of sustainable construction in Ghana? In its

Infancy [ ] Developing [ ] Well-developed [ ] Fully developed [ ]

Section 2: Ranking of Drivers and Barriers of Sustainable Construction

7. In your opinion, what promotes the implementation of sustainable construction in Ghana? Please rank these from 1 (most significant driver) to 15 (least significant driver)

1. Financial Incentives (tax rebates, high profit margin)..... [ ]
2. Legislation and Regulation..... [ ]
3. Client Demand and requirement..... [ ]
4. Company's Reputation and brand image..... [ ]
5. Competitive advantage..... [ ]
6. Awareness and knowledge by top management..... [ ]
7. Stakeholder influence..... [ ]
8. Win more contracts to remain in business..... [ ]
9. To attract and retain right staff..... [ ]
10. Cost efficiency..... [ ]
11. Moral obligation to protect the environment..... [ ]

12. Investment…….. [ ]
13. Clear and consistent guidelines for measuring sustainable construction…… [ ]
14. Life cycle analysis…….. [ ]

Others (please specify)

……

……

8. What more do you think can be done to enhance these drivers of sustainable construction in Ghana, Please indicate your response on a scale of 1 to 5

Not important ……..1

Moderately important ……..2

Neither important nor unimportant……3

Very important……..4

Strongly important……5

	1	2	3	4	5
1. Change in legislation, Building code and byelaws	[ ]	[ ]	[ ]	[ ]	[ ]
2. More tax rebates/subsidies	[ ]	[ ]	[ ]	[ ]	[ ]
3. Better advertising and awareness creation	[ ]	[ ]	[ ]	[ ]	[ ]
4. Clearer means of measuring sustainable construction	[ ]	[ ]	[ ]	[ ]	[ ]
5. Availability and access to green products	[ ]	[ ]	[ ]	[ ]	[ ]
6. Availability of new and integrated technology	[ ]	[ ]	[ ]	[ ]	[ ]
7. Funding of research in to sustainable construction	[ ]	[ ]	[ ]	[ ]	[ ]
8. Higher investment	[ ]	[ ]	[ ]	[ ]	[ ]
9. Lower initial cost	[ ]	[ ]	[ ]	[ ]	[ ]
10. Stakeholders Awareness and understanding	[ ]	[ ]	[ ]	[ ]	[ ]
11. Knowledge of sustainable construction benefits	[ ]	[ ]	[ ]	[ ]	[ ]
12. Availability of Information and database	[ ]	[ ]	[ ]	[ ]	[ ]
13. Education and Training of stakeholders	[ ]	[ ]	[ ]	[ ]	[ ]

Others, please specify:

14. ……

15. ……

9. In your opinion, what hinders the implementation of sustainable construction in Ghana? Please rank these from 1 (most significant Barrier) to 15 (least significant Barrier)

1. Lack of building Code and Regulation ..... [ ]
2. Lack of financial incentives (high taxes and low profit margin)..... ..... [ ]
3. Lack of investment..... [ ]
4. High initial cost..... [ ]
5. Lack of public awareness..... [ ]
6. Lack of client demand..... [ ]
7. Lack of professional knowledge and expertise..... [ ]
8. High cost of environmental Services and technology..... [ ]
9. Competitive Pressure..... [ ]
10. Lack of database and information..... [ ]
11. High level of perceived risk..... [ ]
12. Tendering and contract requirements..... ... [ ]
13. Lack of green products..... [ ]
14. Lack of green technology..... [ ]
15. Insufficient research..... [ ]

10. What more do you think can be done to eliminate these barriers of sustainable construction in Ghana, Please indicate your response on a scale of 1 to 5

Not important 1

Moderately important 2

Neither important nor unimportant.....3

Very important.....4

Strongly important.....5

	1	2	3	4	5
1. Change in legislation, Building code and byelaws	[ ]	[ ]	[ ]	[ ]	[ ]
2. More tax rebates/subsidies	[ ]	[ ]	[ ]	[ ]	[ ]

3.	Better advertising and awareness creation	[ ]	[ ]	[ ]	[ ]	[ ]
4.	Clearer means of measuring sustainable construction	[ ]	[ ]	[ ]	[ ]	[ ]
5.	Availability of green products	[ ]	[ ]	[ ]	[ ]	[ ]
6.	Availability of new and integrated technology	[ ]	[ ]	[ ]	[ ]	[ ]
7.	Funding of research in to sustainable construction	[ ]	[ ]	[ ]	[ ]	[ ]
8.	Higher investment	[ ]	[ ]	[ ]	[ ]	[ ]
9.	Lower initial cost	[ ]	[ ]	[ ]	[ ]	[ ]
10.	Stakeholders Awareness and understanding	[ ]	[ ]	[ ]	[ ]	[ ]
11.	Knowledge of sustainable construction benefits	[ ]	[ ]	[ ]	[ ]	[ ]
12.	Availability of Information and database	[ ]	[ ]	[ ]	[ ]	[ ]
13.	Education and Training of stakeholders	[ ]	[ ]	[ ]	[ ]	[ ]

14. Others, please specify:
15. ……
16. ……

11. Please rank the following factors that affect the implementation of sustainable construction in Ghana from 1 (most significant) to 4 (least significant)
    1. Financial factors …… [ ]
    2. Legislative factors …… [ ]
    3. Knowledge based factors …… [ ]
    4. Professional and Technology based factors …… [ ]
12. Which of these **financial factors** do you think mostly affects the implementation of sustainable construction in Ghana, Please indicate your response on a scale of 1 to 5

Not important ……1

Moderately important ……2

Neither important nor unimportant……3

Very important……4

Strongly important……5

		1	2	3	4	5
1.	Initial cost	[ ]	[ ]	[ ]	[ ]	[ ]
2.	Operational cost	[ ]	[ ]	[ ]	[ ]	[ ]

3.	Additional cost	[ ]	[ ]	[ ]	[ ]	[ ]
4.	Availability of life cycle cost analysis	[ ]	[ ]	[ ]	[ ]	[ ]
5.	Separation between initial cost and operational cost	[ ]	[ ]	[ ]	[ ]	[ ]
6.	Cost of sustainable technology and materials	[ ]	[ ]	[ ]	[ ]	[ ]
7.	Clients demand	[ ]	[ ]	[ ]	[ ]	[ ]
8.	Win more jobs	[ ]	[ ]	[ ]	[ ]	[ ]
9.	Tax incentives	[ ]	[ ]	[ ]	[ ]	[ ]
10.	Investment	[ ]	[ ]	[ ]	[ ]	[ ]

13. Which of these **legislative factors** do you think mostly affects the implementation of sustainable construction in Ghana, Please indicate your response on a scale of 1 (*Not important)* to 5 (*Strongly important)*

		1	2	3	4	5
1.	Building regulations and byelaws	[ ]	[ ]	[ ]	[ ]	[ ]
2.	Tendering and procurement laws	[ ]	[ ]	[ ]	[ ]	[ ]
3.	Contract requirements	[ ]	[ ]	[ ]	[ ]	[ ]
4.	Guidelines for measuring sustainable construction	[ ]	[ ]	[ ]	[ ]	[ ]

14. Which of these **knowledge based factors** do you think mostly affects the implementation of sustainable construction in Ghana, Please indicate your response on a scale of 1 (*not important*) to 5 (*Strongly important)*

		1	2	3	4	5
1.	Research into sustainable construction	[ ]	[ ]	[ ]	[ ]	[ ]
2.	Stakeholders Awareness and understanding	[ ]	[ ]	[ ]	[ ]	[ ]
3.	Information and database	[ ]	[ ]	[ ]	[ ]	[ ]
4.	Adaptation to change	[ ]	[ ]	[ ]	[ ]	[ ]

15. Which of these **professional/technological factors** do you think mostly affects the implementation of sustainable construction in Ghana, Please indicate your response on a scale of 1 (*not important*) to 5 (*Strongly important)*

		1	2	3	4	5
1.	Professional know-how	[ ]	[ ]	[ ]	[ ]	[ ]
2.	Availability of new green technology	[ ]	[ ]	[ ]	[ ]	[ ]
3.	Availability of integrated green technology	[ ]	[ ]	[ ]	[ ]	[ ]
4.	Volume of extra Documentation	[ ]	[ ]	[ ]	[ ]	[ ]
5.	Cooperation amongst professionals	[ ]	[ ]	[ ]	[ ]	[ ]
6.	Availability of green materials and products	[ ]	[ ]	[ ]	[ ]	[ ]

Thank you.