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DEPARTMENT OF BUILDING TECHNOLOGY

ACHIEVING SUSTAINABLE CONSTRUCTION THROUGH PROCUREMENT IN THE GHANAIAN CONSTRUCTION INDUSTRY

BY

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MANAGEMENT

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DECLARATION

I hereby declare that this work is the result of my own original research and this thesis has neither in whole nor in part been prescribed by another degree elsewhere. References to other people's work have been duly cited.

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ABSTRACT

Sustainable construction (SC) is one of the subsets of sustainable development and seeks to achieve social, economic and environmental equilibrium in the procurement of built assets. The benefits that ensue from sustainable construction are of significant value to current and future generations alike. Nonetheless, there is a lack of understanding and application of the concept in the Ghanaian construction sector. This phenomenon has resulted in little attention being given to SC and the benefits thereof. Given that the acquisition of a built asset is through a chain of procurement activities, it becomes important to initiate this process so that SC becomes a demand driven approach to the realisation of SC goal. Hence, this research aims at exploring means of achieving sustainable construction along the procurement route in the Ghanaian construction industry. The research process began with a review of mainstream publications on the subject to gain a broad insight and a sound understanding in addressing sustainable construction and also to glean secondary data. Questionnaire survey and semi-structured interviews were used to collect and validate primary data respectively from 172 professionals in construction procurement for the study. Analysis of the results yielded a set of 12 sustainability factors that included the integration of sustainability requirements into contract briefs, specifications, conditions and in the tendering procedures; the need for contractors and supplies to demonstrate the capacity, innovation and commitment to deliver sustainable project and the provision of records of successfully completed sustainable project. Furthermore, sets of criteria for assessing sustainable construction comprising 10 environmental assessment criteria, 7 economic assessment criteria and 10 social assessment criteria resulted from the study. Finally the analysis also led to the development of 12 sets of factors that outline the role of procuring entities in the

pursuit of SC goals among which are the need for training, knowledge sharing and understanding of sustainability issues among procurement decision makers; incorporation of sustainability issues in procurement decision making; the need for clear policies and guidelines regarding the application of sustainability principles in the procurement of infrastructure and to conduct reviews to monitor the delivery of sustainability requirements throughout the project life cycle . Recommendations provided for the advancement of SC include training on sustainability issues, the need to emphasise sustainability at all stages throughout the procurement process and a proposed framework for implementing, monitoring and evaluating sustainable construction along the procurement route.

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DEDICATION

This thesis is dedicated to my mother, Anita Avorkliya

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LIST OF ACRONYMS

ARB ……..……..Architects Registration Board (UK)

CIOB……..…Chartered Institute of Building

CIPS ……Chartered Institute of Procurement & Supply

CIRIA……....Construction Industry Research and Information Association

DEFRA……..Department for Environment, Food and Rural Affairs

DESA ……...…….. Department of Economic and Social Affairs

DETR …… ……..Department of Employment, Training and Rehabilitation

GCC……...Glasgow City Council,

GDP……..……..Gross Domestic Product

GSS ……...……. Ghana Statistical Service

ILO …….International Labor Organization

LCC…….…… Life Cycle Costs

LCPE……..London Centre of Procurement Excellence

MDAs…….Ministries, Departments and Agencies

MEAT …….Most Economically Advantageous Tender

MMDAs……Metropolitan Municipal andDistric Assemblies

OGC……Office of Government Commerce (UK)

PPA ……..….Public Procurement Act

RIBA…… Royal Institute of British Architects

SAP…….Sustainability Action Plan

SC …….Sustainable Construction

SD ……Sustainable Development

SMMEs…….Small, Medium and Micro Enterprises

SP ……Sustainable Procurement

UN……United Nations

WCED ……World Commission on Environment and Development

WCSD……... World Commission on sustainable Development

WGFSC…….. Working Group for Sustainable Construction

WSSD ……..World Summit on Sustainable Development

CHAPTER ONEINTRODUCTION

1.1 Background

The later part of the 20th century has witnessed urgent calls towards sustainable development like never before. This issue relates to social, economic and environmental sustainability and has become one of the topmost agenda on governments‘ policies the world over (Working Group for Sustainable Construction, 2001). The World Commission on Environment and Development (Brundtland Commission) since 1987 has been at the forefront calling for the development of new methods to measure and assess the advancement toward sustainable development thus far (Pinter, 2013). This call led to the development of the Bellagio Principles in 1996 which was subsequently replaced by the Bellagio stamp in 2009, all being set of guiding principles to measure and assess progress towards sustainable Development (Pinter *et al.*, 2012).

The concept of sustainable development, as defined in the Brundtland Commission‘s brief, embodies the idea of "*Development that meets the needs of the present without compromising the ability of future generations to meet their own needs*" (World Commission on Environment and Development, 1987). In response to the call for a sustainable development, significant efforts have been made by corporations, academia, non-governmental organizations, communities, nations, and international organization towards the attainment of sustainability goals (Hardi*et al.*, 1997). Sustainable development now defines the way forward for the global economy of the twenty-first century and beyond.

Rather than focusing solely on immediate economic gains, countries and the world at large are encouraged to concentrate on achieving simultaneously the three goals of sustainability namely:

- Economic prosperity,
- Social inclusion and
- Environmental sustainability (Sardu, Torabi and Varmazabadi, 2013).

Sustainability emerged because it is believed that current development models being implemented across the globe is unsustainable. With sustainable development issues taking centre stage in the developmental agenda of nations, there have been calls for a paradigm shift, a new approach to development that seeks beyond immediate economic advantages to a more sustainable approach which will result in long term benefits (Mensah and Ameyaw, 2012). Whiles the industrial sector has been drawn into the sustainability debate, it was only imperative that the construction industry, like many others, be called to account (Mensah and Ameyaw, 2012; WGFSC, 2001).

1.2 Towards a Sustainable Construction

In more recent years, there have been conscious efforts by stakeholders in the construction industry to pursue sustainable development. There have been advances in the sector through planning and programming and in some cases even more intricate and comprehensive legislation in the areas of social, economic and environmental sustainability. Others have initiated national policies and approaches for the construction sector to operate effectively and efficiently in what is now referred to as ―sustainable construction‖ (WGFSC, 2001). Sustainable construction incorporates mainstream principles of sustainable development to the construction sector and have become one of many subsets of sustainable development (Sourani, 2008; DuPlessis 2007). The term strives for the attainment of the following objective concurrently namely:

- Effective environmental protection;
- Judicious use of natural resources;
- A social progress that recognizes the needs of everyone and

- Maintenance of high and stable levels of economic growth (WGFSC, 2001). The demand and desire for sustainability interventions within the construction sector is in recognition of the construction industry‘s capability to make a momentous contribution towards sustainable development.

The potential for the construction sector to contribute to social sustainability is enormousgiven that the products resulting from the sector‘s operations are used to reinforce and facilitate all aspects of socioeconomic affairs. This is all the more so given the labour-intensive nature of construction undertakings (with about 111 million employees worldwide) and the opportunities it presents for poverty alleviation (DuPlessis, 2013). A report by the International Labour Organization (ILO)confirmed the observation made by Du-Plessis(2013) above. The report cited the labour intensive nature of the sector, where about 74 percent of its employees are in the low-income countries, as an opportunity for human development and to up the standard of living of the poor (ILO, 2001). Social sustainability also means contributing to a higher social assimilation and to the continuous development of society. In relation to the public, it is vital to ensure urban quality, security, accessibility, access to information, environmental education and usefulness of the facilities as well as urban interventions after the event (Pinto *et al*., 2011).

The construction sector has also the capacity to contribute towards economic sustainability by means of its structures, performance and manner of acting given that the built environment makes up more than 50percent of total national capital investment and construction undertakings represent about 10 percent of gross national product (GNP) all the world over (Du-Plessis, 2013). The sector is also making significant contributions in the creation of small, medium and micro enterprises (SMMEs) whose contribution to the

economy can never be overemphasised. There are other indirect contributions of the construction sector towards economic sustainability. This is evident in the manufacture and sale of goods such as cement, paint, and a large proportion of other building material sold to consumers (Pinto *et al*., 2011).

Environmental sustainability of construction is one area that has received the greatest of attention, a situation attributed to the massive demands it exerts on resources globally (Ebohon*et al*., 2002). A report by the World Watch Institute revealed that construction activities alone make use of 40 percent of the aggregates, gravel and sand consumed globally each year and a quarter of global wood reserves. The sector also consumes more than one-sixth of fresh water globally and consumes between 30 to 40 percent of total global energy. The negative impacts of these activities the report noted, is the attendant resource exhaustion and the loss of biological diversity (fauna and flora) (Baloi, 2003), pollution of air, water and land dereliction (Australian Science, 2011).

In addition to global resource depletion, the sector creates waste on a greater measure in comparison to most industry sectors (Ebohon*et al.*, 2010) making up for between 20 and 30 percent of combined waste generation, which becomes even more profound with the addition of demolition waste. These include the emission of greenhouse gases of which the sector alone accounts for about 30 percent. This is particularly the case when the building and production material phases of the building are combined with the operational phases where the greenhouse gas implication of enhancing the thermal comfort performance in buildings is taken into account (Ebohon*et al.,* 2010).

In the light of the conflicting picture of the rapid depletion of natural resources concurrent with the exponential growth in world population, it is of significant

importance that the associated demands of construction activities on available natural resources are met within the _carrying capacity‘ of the physical bio-space (Ebohon et al., 2011).

Looking into the future, it is predicted that, the world‘s population is likely to double in the coming 40 years. Whilst this presents opportunities for the construction sector in terms of job creation, economic growth and a boost in infrastructure, scarcity of the world resources means that in 40 years, many of the natural resources that are taken for granted such as oil, water, some base metals and minerals, just to mention a few will be in very short supply (Berry *et al.*, 2011). This scenario makes sustainable intervention an urgent requirement in order to meet the ever increasing demand of humanity within the carrying capacity of the earth.

1.3 The Case in Ghana

The situation is not different in Ghana, as the country has been experiencing increased population growth over the last decade. This notwithstanding, Ghana has a huge housing deficit, which stands at over 1.5 million units per household (Ghana Business News, 2012). This situation, coupled with Ghana‘s fast growing economy has given rise to an ever increasing demand for infrastructural development like never before, to adequately meet the demand for Ghana‘s growing economy. This means more housing in the coming years not only to close the gap of deficit in housing, but more so to accommodate the ever increasing population.

As noted earlier, this phenomenon has the potential of over utilisation of resource not to mention the environmental and socioeconomic impacts. In many parts of the world there is a conscious effort geared towards sustainability which seeks to build on a shared commitment to procure in a more sustainable way and focuses on promoting the business

case for better procurement practices in the public and private sectors (Strategy for sustainable construction, 2008). Thus the practice of sustainable procurement provides the means to achieve economic, social and environmental sustainability in procurement without harming the integrity of the process (Ameyaw*et al.*, 2012).

Procurement in Ghana emphasises more on the attainment of value for money, while little attention is given to the issues of sustainability. Existing legislations and regulation do little to address the issues of sustainability in the procurement process, placing more priority on judicious use of state resources and fairness in the procurement process. This trend must not be allowed to continue. The time has come for stakeholders to take a long-term view when making decisions to ensure that whiles meeting our own needs, we are not compromising the needs of others now and in the future and this means taking responsibility for the local, regional and global effects of our way of life (Berry *et al.*, 2011). It is also of utmost importance that, the interpretation of public procurement legislation (such as the Public Procurement Act,Act 663) respects its primary objective, which is economic in nature whilst at the same time integrating the sustainability aspects, without, however, these sustainability aspects replacing the primary objectives of public procurement (WGSC, 2010).

The process of procurement in construction can span from an in depth needs assessment to market analysis, tender and evaluation process to a simple work instruction to a subcontractor. Irrespective of the approach adopted, sustainability requirements should be emphasized from the start so that decisions made during all stages of the construction procurement process are important for the realisation of sustainability.

1.4 Problem Statement

Construction has been on trial for causing environmental problems spanning from excessive use of global resources, both in terms of construction and building operation to the pollution of the bio-space (Du-Plessis, 2013). Research has shown that contractors and consultants in Ghana are aware that their activities negatively impact on the environment. Among the issues observed are depletion of natural resource, large amount of material wastage, excessive consumption of energy resources, massive loss of arable land among others (Ayarkwa, 2010). The loss of vegetation greatly affects the quality of air we breathe and hence our health. Urbanisation is replacing the vegetation with roofing and hardstand areas which causes―flash‖ flooding(Ebohon*et al*., 2002).

Along with the environmental issues comes the socioeconomic impact of construction activities. This is evidenced in comfort disturbance, resident displacement and deteriorating health conditions that construction activity brings to society (Shin and Li, 2012; Baloi, 2003). Demolition of affordable existing residential dwellings, the removal of slums in central city areas and the expropriation of land from local dwellersin order to make way for new mega-structures and to make over the city image to match the _world class cities‘ often result in constraints of the economic activities of the community dwellers as well as present threats to their only means of income sources (Bhan, 2009). This situation, as observed by Steenveld and Strelitz (1998) is even more profound in third world countries.

The industry also has a reputation for greed, corruption, high rates of gender discrimination and bad labour practices. Sexual harassment continues to limit the equal participation of women in the industry. According to a study by the International Labour Organisation, the construction sector also has a very poor safety record, a situation

attributable to the lack of official training to the unregulated informal sector (ILO, 2001). The unstable nature of the industry, together with a high turnover of casual workers, is also contributing to the failure of the apprenticeship structure, and consequently to a reduced national skills base.(Plesis, 2002)

Besides the social, economic and environmental odds discussed above, there is also an absence of an appreciation of sustainability concept even among practitioners in the Ghanaian industry. Attempts to a sustainable construction practices, in most cases, have only been a mere ―window dressing‖ rather than a genuine commitment to the issue(Ameyaw*et al*., 2012; Sourani, 2008).

Lack of integration of sustainability criteria into standard procurement processes and the conflict between sustainable procurement and reducing cost has been identified as another pressing issue (Sourani, 2008). National governments and civic organisations together constitute the construction sector‘s principal client. It is they who must take a lead in stimulating sustainability in construction so that it becomes a course focussed in the paramount interests of the client. The researcher believes that sustainable construction can best be achieved through a comprehensive and well-organized sequence of procurement processes by making it one of the topmost priorities from inception through to the whole life of the project.

1.5 Research Questions

In view of the numerous odds identified with construction procurement above it is imperative to find answers to the following questions which form the basis of the research objective as discussed under section 1.6 thus:

- What are the key factors in the procurement process that aid in achieving sustainable construction?

- What are the criteria for assessing sustainable construction at the various stages of the procurement process?
- What role do procurement entities have to play in achieving sustainable construction procurement?

1.6 Research Aim and Objectives

The problem statement presented under section 1.4 and research questions raised under section 1.5 above provides the basis for establishing the aim and objectives of the research.

1.6.1 Research Aim

The research aims at exploring means of achieving sustainable construction along procurement route in the Ghanaian construction industry.

1.6.2 Research Objectives

The following objectives are set to achieve the research aim outlined above thus:

- To determine factors in the procurement process that aid in achieving sustainable construction (sustainability factors).
- To define criteria for assessing sustainable construction in the procurement process (assessment criteria)
- To identify the role of procuring entities in achieving sustainable construction
- To develop a framework for implementation, monitoring and evaluating sustainable construction procurement.

1.6 Scope of the Research

The scope of this research was to explore the possibilities of incorporating sustainability principles in the infrastructure delivery process along the procurement routes form needs

assessment to commissioning of project. The research delves into the procurement of infrastructure and related services with respect to sustainable procurement.

1.7 Justification of the Study

A World Bank report carried out by the Division for Sustainable Development on Ghana shows that policies and campaigns for sustainable development has been skewed toward the transport, energy and mining sectors with very little attention given to the construction sector. As a foremost construction client, Government has a significant part to play in pushing forward the sustainability agenda by refining its own performance and translating that into its demands on the industry. Currently Government procurement policy necessitates all public procurement to be carried out on the basis of value for money and fairness in the procurement process (PPA, 2003). Value for money is the optimal amalgamation of whole life costs and quality to meet the consumers‘ desires. Although the predominant aim of procurement must at all times be the attainment of value for money and not the delivery of policies such as sustainability, there is much that can be done on sustainability concerns inside the value for money approach. This is what the research is about and hence its importance.

1.8 Structure of the Research

The research is structured in six chapters following a generic approach in academic dissertation. Each chapter begins with an introduction of the themes presented and in some cases ends with a section that summarises the chapter. The composition of each chapter as presented in the literature is outlined in figure 1.1. The figure also highlights the relationship between the various chapters.

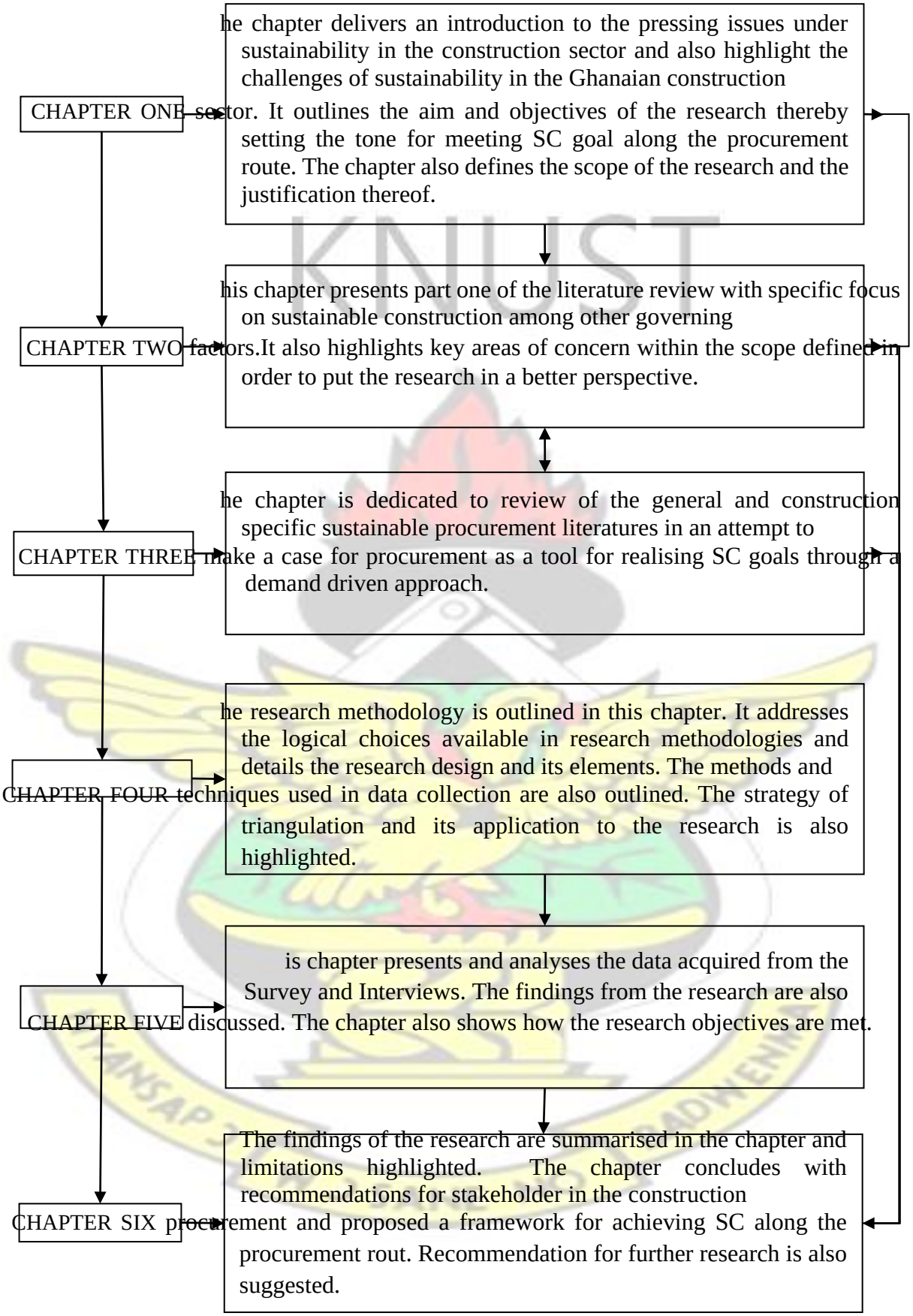

Figure 1.1 Structure of the research

CHAPTER TWOLITERATURE REVIEW

2.1 Introduction

This chapter presents a review of rich contemporary literature on the subject matter, with a particular attention on the terminology, origin, fundamental concept and conventional views on sustainability in general, and sustainable construction in particular, among a number of prevailing factors. Further, by means of the evolving body of sustainability literature, the chapter presents an overview of the sustainable construction discussion. It concisely describes the impact of the construction sector on the environment and society, and summarizes some of the challenges of sustainable construction.

The literature presented in this chapter was intentionally sampled with the objective of gaining a comprehensive discernment into sustainable construction. This mandated the collection of information rich literature on numerous sustainability facets in the construction sector for investigation. Clustered relevant facts in numerous evolving themes, embodied in the several segments of the paper were compared. In function of the themes that emerged a continuous selection of literature was carried out until a thorough understanding of each was reached in addressing sustainable construction procurement which provided the basis of setting the aim and objectives of this research as outlined under section 1.6

2.2 Sustainability and Sustainable Development

A distinction is often made between ―sustainable development‖ and ―sustainability‖. Some scholars are of the view that ―sustainable development‖ is predominantly about economic progression, while ―sustainability‖ lends priority to the environment (Wass*etal.*, 2011). Another school of thought emphasises that Sustainability is the situation which sanctions the sustained existence of man, and affords a safe, healthy and productive life in congruence with nature, native culture and spiritual values, whereas Sustainable development is the kind of development to pursue so as to attain the state of sustainability

(Du-Plessis, 2003). Evidently these two definitions complement each other. Nonetheless, the two terms, sustainability and sustainable development are often used synonymously, a situation attributable to the fact that both terms have general positive connotations (Otto, N/D). According to Wittgenstein (1977: in Qtto, 2010), a synonymous use of the terms is possible due to the fact that such use is not necessarily connected to their logical construction. Reference is also cited for the German speaking area where sustainability is often used as a short form of Sustainable development (Brand, 2004: in Qtto, 2010).All through this literature, the expressions ―sustainable development‖ and ―sustainability‖ are employed with no intention of differentiating in meaning concerning the two.

2.2.1 Defining Sustainable Development (SD)

Sustainable Development has been defined differently by various disciplines and with different assumptions (the concept embodied therein) about the basic relationship between society and nature (Elliot, 2006). It is believed that there exist more than 200 definitions of sustainable development (Parkin *et al.*, 2003). The numerous definitions of this subject, according to Sourani (2008) arise as a result of increasing recognition of the concept. Nonetheless, there are widespread agreement about the concept‘s meaning between sustainability scholars and practitioners.

Most definitions of SDhowever are centred on the nominal definition contained in the Brundtland Commission‘s brief as: ―*development that meets the needs of the present without compromising the ability of future generations to meet their own needs*‖ (WCED, 1987). Munier (2005) described this developmental process in the definition above as involving institutions, people, natural resources and the environment, and which is to be implemented collectively and really points towards the future.

Also and less frequently mentioned is the operational definition of *SD —a process of change in which the exploitation of resources, the direction of investments, the orientation of technological development, and institutional change are all in harmony and enhance both current and future potential to meet human needs and aspirations*‖ (WCSD, 1987).

It could be inferred from the above two definitions that sustainable development takes into account the past, present and the future as a whole system and gives equal emphasis to human, socioeconomic development and the conservation of natural bio space as observed by Zhou *et al.* (2006).

2.2.2 The Concepts of Sustainable Development

While Sustainable development is by and large regarded as a new development model that became prominent during the late 20th century, the concept in reality, though, is much older (Waas*et al*., 2011). There exist as many views over the concept as scholars dealing with the subject. According to Munier (2005), the concept is a difficult and complex issue, and an elusive one. His argument is supported by Phillis*et al.* (2014) who describe Sustainable development as an inherently vague, uncertain, and polymorphous concept whose precise definition and scope still lack extensive recognition.

There appears to be great ambiguity in the concept‘s interpretation and many reasons have been ascribed to this. As noted by Waas*et al*. (2011), the normative nature of sustainability, the varied disciplines and professional orientation of scholars dealing with the subject, the scuffle for influence over the concept‘s meaning and the applicable means to realize it, knowing the significance of the concept for future development of society and its prominence in numerous discourse, are all contributing factors.

Nonetheless, most of the concepts developed, however, encompass the idea of three mutually dependent pillars, namely: environmental, economic and social sustainability.

This concept is generally referred to as the concept of ―triple bottom line‖ and have gained wide consensus among scholars of different disciplines and professional background. Barbier (1987, cited in Elliot, 2006) presented these as three interlocking circles as seen in Figure 2.1. The objective of sustainable development is to make the most of the benefits across all three systems and is demonstrated by the intersection of three circles.

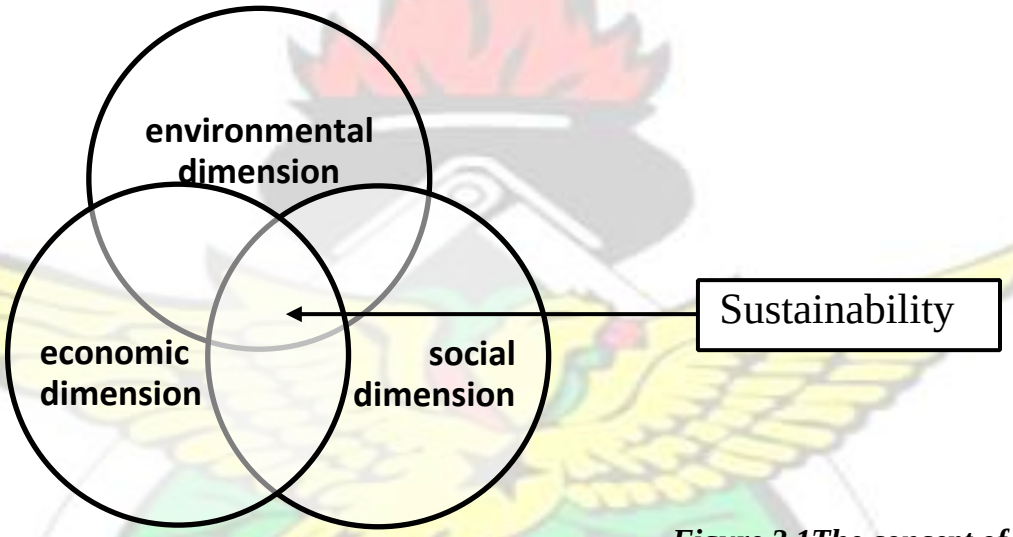

Figure 2.1The concept of triple bottom line (Barbier, 1987)

According to Plessis (2007), the three pillars proposed by Barbier (1987) highlight the multifaceted nature of sustainable development. It is argued further that a sustainable development scheme that provides jobs to the detriment of the environment, or a renewable energy development that ignores the environmental and social impact, displaces thousands of people and reduces biodiversity, is a setback to its own purpose.

Generally it could be argued, as did Plessis (2002), that sustainable development must be viewed as an integrative and holistic principle that strives for agreement and equilibrium between the three circles illustration presented above.

2.2.3 Sustainable Development/Sustainability - A Historical Overview

Sustainable development is primarily regarded as a new development model that became prominent during the latter part of the 20th century, though in reality, the concept dates back into time. Problems, notions and practices that are currently classified under the sustainability umbrella have a historical antecedent that dates back to many thousands of years (Waas*et al*., 2011). The term ―sustainability‖ in itself is much older than often thought. The German version of the term, ―*NachhaltendeNutzung*‖ (sustainable use) is well documented (Carlowitz, 1713; in Elliot, 2006).

Contemporary understandings of sustainability came into light during the early 1950‘s at the end of the second world war when economic progression heightened the prospects of a higher living standards all the world over and during the end of the 20th century when remarkable progress in development was observed in many countries (Waas*et al.*, 2011). During the 1950s and 1960s, economic prosperity and increased economic production became the main focus of development. By the early 1970s, the huge and increasing poverty gap in the third world countries, coupled with the inequitable distribution of the benefits of economic growth with these countries led to a renewed attempt and call for more equal welfare dissemination. By the 1980s, environmental protection became the third major objective of development as it became clear that the stability of the world environment is being threatened by human activities, as a result of unsustainable consumption behaviour, one that portrays extreme disparities (DESA,

2013).

Unsustainable lifestyles also place immense stress on the environment. It was also during the last decades of the 20th century, an epoch of unparalleled scientific and technological advancement, coupled with an exponential population growth that humanity began to exceed the carrying capacity of the Earth (Rockstrom, 2009), undermining its environmental state with negative consequences and even cataclysmic once to current and future generations in large parts of the world (Reid, 2005). Humanity, then became conscious of these imminent threats and the terrible damage caused to the environment, a phenomena that led to a new orientation with regards to what constitutes economic progression and ―successful‖ development (Du-Pisani, 2006), calling for a change from exploitative industrialism—―business as usual‖—to sustainable development (Waas*et al*., 2011).

In fact, sustainable development came about as a result of different ideas regarding progress, environmental protection, economic growth and development which have evolved over several decades (Plessis, 2006). The theoretical foundation of modern understanding of the sustainability concept is a product of several scholarly studies, which are interconnected (Waas*et al*., 2011).

Sustainable development was adopted as a leading development model by the International community at the end of the 20th century (Rogers *et al.*, 2008; Reid, 2005; Dalal-Clayton *et al.*, 2002), with action-driven power that calls for precise orientations of actions. To this day sustainable development has been universally acclaimed as a desirable policy objective among many institutions who are concerned about the future development of the global resources (Elliot, 2006). Furthermore the concept is conceived by many as the appropriate approach to tackle the vast, multifaceted and interconnected

environmental and socioeconomic problems and is deemed highly imperative for the sake of current and future generations. In the light of this, sustainable development whiles representing a solution for environmental and socioeconomic problems, provides at the same time sets of principles implying positive objectives, a focus for positive change, and an appraisal on traditional thinking and practice. (Waas*et al.*, 2011).

Ghana is endowed with both renewable and non-renewable resources such as forests, water, soils, coastal and marine. However, these resources are under serious threat. For this and many other reasons, there is a need for sustainable interventions now for a sustainable future.

2.3 Sustainable Development, a Global Order

The introduction of the concept of sustainable development by the Bruntland commission in 1987 has been followed by many world events aimed at increasing the awareness on socioeconomic and environmental sustainability (Abidin, 2010; Grober, 2007**)**. The understanding of sustainable development currently encompasses the challenges and opportunities presented by a globalising world (Elliot, 2006). Sustainable development remains central to international agendas as encompassed in the outputs of major UN conferences. Table 2.1 outlines some notable milestone at the world stage with respect to sustainable development.

***Table**2 .1: Sustainable Development Mile Stones. (Source: compiled by Author)*

Event	**Main Agenda**

United Nations Conference on the Human Environment (UNCHE; 1972)	Declaration on the Human Environment ("Stockholm Declaration") setting out key principles to guide States' actions on the environment; an Action Plan for concrete and specific environmental actions and measures; and a Resolution on Financial and Institutional Arrangements. (Galizzi, 2005)
World Conservation Strategy (WCS; 1980)	This was a major attempt to integrate the environment and development concerns into an umbrella concept of ―conservation.‖(Mebratu 1998)
Our Common Future (1987)	Stressed the inextricable connection between environment and development and introduced the concept of sustainable development(Galizzi, 2005)
Earth Charter (2000)	To declare a fundamental ethical principles for building a just, sustainable and peaceful world society in the 21st century. It seeks to arouse in all people a new sense of global interdependence and shared responsibility for the well-being of the whole human family, the greater community of life, and future generations. It presents a vision of hope and a global call to act. (Charter, 2000)
United Nations World Summit on Sustainable Development (WSSD; 2002)	To assess the progress and global implementation of sustainable development.

There now appears at last to be a growing commitment to reverse unsustainable trends in development (Halliday, 2008).The need for wider consideration in the context of sustainability has now been accepted by governments, organisations, commerce, and the

society at large (Abidin, 2010). Sustainable development is now the stated policy of the international community, civil society groups and of much industry and commerce. Sustainable development is also being claimed as a major policy goal by international organizations, including the World Bank and the World Trade Organisation. As countries all the world over are striving to make sustainability an integral part of their developmental agenda, businesses are also rethinking the way they operate to minimise their impact on the environment and to be more socially responsible in the setting of economic goals. It is also worth noting that consumers are also showing increased preference for sustainable products and thus green markets are considered to be the markets of the future. Stakeholders are becoming more aware of the global challenge and are using their power to exert pressure on the companies as evidenced by growing numbers of green consumers (Adetunji*et al.*, 2003).

2.3.1 National and Institutional reforms

An increasing number of countries are striving to make sustainability a central part of their developmental agenda. A report by the Department of Economic and Social Affairs (DESA, 2013), shows that developing countries have put forward initiatives that are more advanced than those accomplished by their developed counterpart so far. An example is given of Ecuador and the PlurinationalState of Bolivia who have enshrined the ―rights of nature‖ in their recent constitutions. Many third world countries are building their own sustainable lifestyle and consumption behaviour, and offers aspirational models.

There has been increased awareness among governments and multilateral institutions that it is impossible to disassociate economic development from environmental issues and. Observations have also been made to the effect that many forms of development eat away the environmental resources upon which they founded, and environmental degradation pose a significant threat to economic development. Poverty is regarded as a primary cause

and effect of global environmental problems. It will therefore be an attempt in futility to deal with environmental problems without an extensive outlook that incorporates the factors underlying world poverty and international disparity (WCSD, 1997).

Sustainability is an issue which is being given increasing attention by industry and pressures are increasing for businesses to improve sustainability performance (Belfitt*et al.*, 2011). One of such industry is the construction industry. The section that follows discusses sustainability in relation to the construction sector.

2.4 Construction and Sustainability

Having discussed the historical antecedent and uses of the term "sustainability", the objective of this section of the literature review is to deliberate on the concept of sustainability within the construction sector and to advance an understanding of the term "sustainable construction.

2.4.1 Construction

Construction has been defined as ―*the broad process/mechanism for the realisation of human settlements and the creation of infrastructure that supports development*‖ *This includes the extraction and beneficiation of raw materials, the manufacturing of construction materials and components, the construction project cycle from feasibility to deconstruction, and the management and operation of the built environment*‖ (Du Plessis*et al.*, 2002). The construction industry comprises all who plan, develop, produce, design, build, alter or maintain the built environment. The sector also includes suppliers and manufacturers of construction products and material, clients, consultants, contractors as well as end users of a facility (Baloi, 2003).

The sector is counted among the key contributors of national development, furnishing the requisite infrastructure and physical edifice vital for economic and social activities

including business, services and utilities. The sector generates employment opportunities and injects capital into nations‘ economy through the creation of foreign and local investment opportunities (Agung, 2009).

There has been call for the sector to embrace the principles of sustainability in its operation. Reasons for this call and the benefits to be derived thereof form the subject matter of the sections that follow.

2.4.2 Sustainable Construction (SC)

Sustainable construction, like its parent model, sustainable development, has numerous definitions with none of these definitions being wholly satisfactory (Plessis, 2002; Adetunji*et al.*, 2003; see Table 2.2). Generally speaking, Sustainable construction is the application of the principles of sustainable development to the construction sector (Sourani, 2008; Opoku, 2011; Adetunji*et al.*, 2003 among others). This argument is supported by Parkin (2000), who describes sustainable construction as a process that incorporates the basic themes of sustainable development. SC provides a platform for the construction industry to contribute towards the attainment of sustainability goals, taking into account environmental, socioeconomic and cultural issues (Shafii*et al.*, 2006). Du-Plessis (2002, cited in Reffat, 2004) noted that Sustainable construction looks beyond environmentally orientated building designs, but more importantly environmentally friendly construction operation and maintenance procedures. She argued further that not only must construction materials and components be produced in a sustainable way, but their use must also answer to new requirements deriving from holistic environmental prerequisites. The definition offered by Du-Plessis (2002) takes sustainable construction further than just minimization of negative environmental impact, as seems to be the case for other definitions provided (see Table 2.2). Here it also espouses the idea of

environmental restoration, and also highlights the social and economic aspects of sustainability, a key proponent of the sustainable construction concept as will be seen in sections that follow.

2.4.3 Sustainable Construction- The Concept

The concept of triple bottom line for sustainable development also holds true for Sustainable construction as a reflection of those issues in relation to sustainable development. As noted by authors Abidin (2010), Baloi (2003) Plesis (2002), among others, the concept of sustainable construction hinges on three main pillars:

- Environmental Sustainability,
- Social Sustainability and
- Economic Sustainability.

2.4.3.1 Environmental Sustainability

The Environmental sustainability dimension of SC is concerned with the built and natural environment and how these are impacted by the activities of the construction sector (Abidin, 2010; Adetunji*et al.*, 2003; Parkin *et al*., 2003). The built environment refers to the activities within the construction project itself, whereas the natural environment refers to the bio-space (Abidin, 2010). Environmental sustainability advocates for the prevention of harmful deteriorating and irreversible damage to the environment and the ecosystem through prudent extraction and use of natural resources, waste minimisation and disposal, energy and water efficiency among others, thereby reducing ecological impacts today in order to preserve the environment for the upcoming generations (jones *et al*., 2010; Adetunji*et al.*, 2003; Abidin, 2010).

According to Baloi (2003), the environmental consideration encompasses the design, construction, operation, maintenance and deconstruction phases of the construction activity,

all geared towards minimizing the adverse impacts on the environment as discussed previously.

2.4.3.2 Social Sustainability

According to Parkins *et al.* (2003), many people find it more difficult to get to grips with the social dimension of sustainable construction. The social sustainability dimension of sustainable construction involves the responsible execution of business based on the principles of ethics, legal, and moral obligations of the construction industry to its stakeholders such as employees, suppliers and the community in which it operates (Jones *et al.*, 2010; Adetunji*et al.*, 2003). It aims at the enhancement of people's quality of life (Baloi, 2003). Social sustainability takes into consideration human feelings: security, satisfaction, safety and comfort and human contributions: skills, health, knowledge and motivation (Abidin, 2010). Social sustainability also requires that construction undertakings and the design of settlements allows for cultural continuity, social inclusion, and other quality of life issues (Plessis 2002).

It has been observed that the construction sector has a high potential to deliver social sustainability, giving the labour intensive nature of the sector and the opportunities it present for poverty alleviation (Du Plessis, 2002).Nonetheless, this dimension of sustainable construction is often the least considered despite the huge potential it holds (OGC, 2007).

2.4.3.3Economic Sustainability

Economic sustainability has to do with the fiscal gains from the project for the benefits of the clients and other construction players, the public and the government through improved project delivery resulting in high productivity to maintain a high and stable level of economic growth (Parkin *et al*., 2003; Abidin, 2010; Jones *et al*., 2010). It also

addresses economic prospects such as job creation, competitiveness enhancement, and minimal operation and maintenance costs (Baloi, 2003).

The construction industry also has the potential to enhance economic sustainability through its structure, conduct and performance. Plessis (2002), identified some key contribution of the sector towards economic sustainability as follows:

- Sustained employment opportunities through formal construction, material production and distribution,
- Sustained employment through related services like transport, financial, marketing and rental/sale of property.
- Sustained employment through operation and maintenance during the economic lifespan of the buildings.
- Sustained investment and capital formation opportunities for the economy.

However, Beheiry*et al.* (2006, cited in Opoku, 2011) believes that sustainability efforts in construction projects are biased towards the environment in comparison to the social and the economic dimensions. This could be attributed to the fact that the environmental issues in sustainable construction are well understood and easy to measure in comparison to the economic and social dimensions (Adetunji*et al.*, 2003). But good understanding of economic and social sustainability and their inter-linkages needs to be developed further (Adetunji*et al*., 2003).

Besides the three dimensions aforementioned, Zabihi*et al.* (2012) presented a fourth dimension to sustainable construction as being Technical where flexibility and adaptability optimization is identified as the main issue.

Table 2.2: Definitions of sustainable construction (compiled by Author)

DEFINITIONS OF SUSTAINABLE CONSTRUCTION	SOURCE
Construction activities whose negative impacts are minimized and positive impacts maximized so as to achieve a balance in terms of environmental, economic and social performance.	Kamar*et al.*,cited in Zabihi*et al.*, 2012
The creation and responsible management of a healthy built environment based on resource efficiency and ecological principles	Zabihi*et al*,.2012
Bio-physical and socioeconomic responsiveness in the production and habitation of the built environment at all levels of construction	Irurah(year N/A)
_The ways in which built assets are procured and erected, used and operated, maintained and repaired, modernized and rehabilitated and reused or demolished and recycled	Kibert, (1994) in Baloi, D (2003)
A holistic process aiming to restore and maintain harmony between the natural and built environments, and create settlements that affirm human dignity and encourage economic equity.	Du plesis (2003)

2.4.4 Sustainable Construction Themes

Sustainable constructions embrace a number of themes most of which are being practiced either as a standalone theme or together with others for the attainment of specific objective(s) (not necessarily sustainability) such as waste minimisation, cost reduction, energy efficiency among others. These themes in themselves falls under, at least one of the three dimensions of sustainable construction, i.e. social, economic and environmental dimensions. The Sustainability Action Plan (SAP) 2012-1015 produced by the UK Government for the construction industry to contribute towards sustainable development includes some of these themes discussed below (GCC, 2012).

2.4.4.1 Lean Construction

Lean construction aims at eliminating waste and other aspects that offer no added value to the process, thereby producing assets that better meet the needs of the client across its life span (Cartlidge, 2004). The need to aim for lean construction is one of the themes of sustainable construction procurement offered by the UK Office of Government Commerce towards the achieving sustainable construction (Ofori, 2006; Opoku and Fortune, 2011). According to Sourani and Sohail (2013) lean construction provides a crosscutting theme, one that affects the delivery of certain sustainability criteria through, for example, obtaining better quality built asset, improved efficiency in the use of resources, reducing and managing waste, achieving cost and time savings, and realising value for money. The adoption of lean construction technique therefore contributes to achieving sustainable construction (Sourani, 2008). Studies have also linked lean construction to curbing the challenges of the triple bottom line of sustainability (Sarhan and Fox, 2012).

2.4.4.2 Green Themes

Green themes such as greenarchitecture, green design, green construction, intelligent buildings and many similar themes are now the new terminologies taking centre stage for the now and the construction of the future, having been evolved for the delivery of sustainable construction (Subramanian, 2007; Pettifer, 2004; Abidin, 2009).

All have one key objective, i.e. giving priority to the environmental performance of buildings using processes that result in low-carbon emission and low energy technologies from design to construction, operation, maintenance, renovation, and demolition (Australia science, 2010; Sodagar and Fieldson, 2008). In an attempt to encourage students to turn their understanding of environmental design into action, institutions such as the Royal Institute of British Architects (RIBA) and the Architects Registration Board (ARB) in UK have made mandatory the teaching of sustainable design to architecture students. This action has been hailed as the right step towards promoting the uptake of sustainability by the profession (Sodagar and Fieldson, 2008). Green procurement, according to Qiao and Wang (2011) is not a synonym to sustainable procurement. They argued that it is a sub-concept referring to the environmental dimension only.

2.4.4.3 Life Cycle Costing (Whole Life Costing)

Life cycle costing (also referred to as whole life costing) is a popular theme that runs through the concept of sustainable construction. It refers to the cost of an asset throughout its life and takes into account planning, design, acquisition, operation, maintenance and disposal, less any residual value (Berry and McCarthy, 2011). Life cycle costing is considered a necessity due to the long service life of construction assets (COM, 2011). Life cycle costing according to Subramanian, (2007) plays a vital role in the development of sustainable construction. In a report by the Working Group for Sustainable Construction (WGFSC, 2001) life cycle costing was proposed as one of the strategies for raising the level of sustainability in construction. Given the objectives of sustainability it

could be argued that a built asset that has a low initial cost, but which will result in a high running and maintenance cost to end users is not sustainable. Life cycle cost is, for that matter a necessary tool for the design of assets that are more consistent with the concept of sustainable construction (Akbiyikli and Eaton, 2006).

2.4.5 Sustainable Construction - A Necessity

The role of the construction industry towards the attainment of the socioeconomic developmental goals of providing employment, infrastructure and shelter are much acknowledged (see section 1.2). Human Settlements constitute the birthplace of our development and for that matter the processes of creating and operating these settlements plays a significant part in the attainment of sustainable development goals. Sustainable construction is one of the key progressions towards sustainable development and is seen as a holistic process aiming to re-establish and sustain harmony between the natural and the built environment, and to create settlements that affirm human dignity and encourage economic equity (Plessis, 2002). Sadly though, the construction industry has been under great criticism as the unsustainable pattern of development models being pursued currently in the sector become a common knowledge. These developments have led to a massive drive towards the quest for a sustainable construction (Dobson *et al*., 2013). The main issues that call for a sustainable construction are as follows:

2.4.5.1 Resource Consumption

The phrase ―40 percent industry‖ has been coined and attributed to the construction sector as it accounts for about 40 percent of combined resource consumption and 40 percent of combined waste production (of which greenhouse emissions are of no exemption) through activities ranging from the manufacturing of materials to the operational activities on and off site (Plessis, 2002). Observation shows that construction activities consume most of unrecoverable resources, accounting for about one-sixth of

global fresh water, a-quarter of global timber as well as two-fifths of global material and energy flows(Ebohon*et al.*, 2002; Zabihi*et al.*, 2012).

As argued by Ebohon*et al.* (2002), it has become necessary to balance the rising demands on global natural resource consumption with the 'carrying capacity' of the physical bio-space, especially in the light of the conflicting scenario of the rapid depletion of global natural resources and the ever increasing world population.

2.4.5.2 Waste Generation

It‘s been observed that the construction sector generates waste on a grand scale in comparison with other industrial sectors (Ebohon*et al.*, 2002). Research has shown that, about 10 to 30 percent of waste disposed of globally in landfills emanates from construction and demolition activities (Fishbein, 1998) resulting in grave environmental problems in many large cities (Begum *et al*., 2006; Chen *et al*., 2002; Teo and Loosemore, 2001). For example, it has been estimated that 70 million tons of construction and demolition waste, including clay and topsoil was generated in 1989 in the UK alone, for which reason SC is considered necessary to the wider UK environmental agenda (Ebohon and Rwelamila, 2002).

2.4.5.3 Environmental Dereliction

The sector has been linked to global warming, environmental pollution and degradation through depletion of the global resource reserves, degradation of fragile ecosystems, chemical pollution and the use of harmful building materials (Agenda 21, 1992). Half of the total carbon dioxide and almost one-quarter of ozone depleting gases come from the energy consumed in the operation, extraction and preparation of materials among other observed sources (Zabihi*et al*., 2012; Ebohon*et al*., 2002). The construction industry has

also been a major contributor to the loss of farmland, release of toxins into the atmosphere, and deforestation (Jones and Greenwood, 2009; Plessis, 2002).

2.4.5 4 Negative Social Image

The construction sector, according to transparency international (2000), has a reputation for greed and corruption not to mention unjust labour practices. In a study conducted by the International Labour Organisation (ILO), it was revealed that construction workers almost everywhere in the globe do not view their employment in a favourable light. The study also revealed that most workers in the construction industry are working out of necessity and seldom out of choice. Another observation made is the high rates of gender discrimination and sexual harassment, a phenomenon that hinders the equal participation of women in the sector.

2.4.5.5 Poor Safety Records

According an ILO study, the safety record of the sector is poor. The report also noted that the situation is worse in third world countries where accidents often go undocumented due to the absence of adequate insurance policies for construction workforce. Other studies show that accident and fatality rate in many developing countries are considerably higher than in Europe, U.S. and Australia (Idoro, 2004 and 2007). Lack of formal training and subcontracting to the unregulated informal sector also constitute the poor safety recordof the sector.

In the light of the on-going argument, there is now a growing realisation that the construction sector has a vital contribution to make towards sustainable development (Opoku, 2011). The quest for sustainability has put enormous pressure on the construction industry from governments and the general public to improve on its current unsustainable pattern of project delivery (Adetunji*et al.*, 2003). Unfortunately the industry seems to be

slow in adopting sustainable approaches in its construction project practices, as observed by Leiper*et al.,* (2003, cited in Opoku, 2011).

2.4.6 Sustainable Construction in Developing Countries

It‘s been recognised that the developing countries have very different characteristics in terms of climatic conditions, cultural orientation and economic progression compared to their counterparts in the developed world. This fact, coupled with the different regional understandings of sustainable construction, and to address the unique needs and challenges of developing countries led to the formulation of ―Agenda 21 for Sustainable Construction in Developing Countries‖, a publication by the International Council for Research and Innovation (CIB), launched as a discussion document during the World Summit on Sustainable Development in Johannesburg in 2002(Shafii*et al.*, 2006; Baloi 2003; Plessis, 2002).

The document, prepared entirely by experts from developing countries constitutes a much broader action driven plan for implementing Agenda 21 on Sustainable Construction, and to further the CIB‘s proactive approach on sustainable construction (Plessis, 2002).

The agenda focuses on issues which can be addressed through sustainability interventions in the built environment. The following are the objectives as outlined in the publication:

- *To identify the key issues and challenges facing sustainable construction in the developing world, as well as the major barriers to practising sustainable construction.*
- *To identify a research agenda that focuses on possible responses to the challenges and needs of the developing world.*

- *To guide international investment in research and development in the developing countries.*
- *To stimulate debate and encourage the exchange of learning on sustainable construction within the developing world, thus drawing the developing world into the international debate as an equal partner.*

The need for sustainable construction interventions in developing countries have been affirmed by authors such as Reffat (2004), siting the rapid rate of urbanization experienced in that part of the world and its attendant pressure on the often limited resources.

According to Plessis (2002) the underdevelopment in third world countries presents an opportunity for development in these countries to avoid the problems being experienced in the developed countries by choosing a developmental path that incorporates the principles of sustainability.

2.4.7 Sustainable Construction in Ghana

Unsustainable design and construction processes and its attendant degradation of the environment for construction purposes is a common phenomenon observed among most developing countries, of which Ghana is of no exemption (Djokoto*et al.*, 2014). The main mitigating factors again sustainable construction are resistance to change, lack of demand of sustainable product, lack of strategies to promote sustainable construction ,higher final cost, lack of public awareness and government support among others(Djokoto*et al.*, 2014).

2.4.8 Barriers to Sustainable Construction

A review of literature shows that Implementation of sustainability in construction, especially among third world countries is slow. The following subsections discuss some of these barriers to sustainable construction.

2.4.8.1 Perceived High Cost

A major setback militating against the adoption of sustainable construction practices is the perceived additional cost of sustainable building and its resulting low profit margins (Halliday, 2008; Reffat, 2004). One of the primary excuses cited for non-compliance with standards and practices based on principles of sustainability, as noted by Reffat (2004) is the additional investments in machinery, equipment and training required. These phenomena as noted by Halliday (2008) have prevented positive action except by the most committed. It is believed that construction industries will pursue sustainability only if it accords some savings somehow. Moreover, besides energy efficiency aspects of sustainable construction which is believed to lead to immediate payback, a majority of clients have not been interested in any sustainable features (Shafii, 2006).

While admitting that the change to sustainable construction will incur some costs, Miranda and Marulanda (2002; cited in Reffat, 2004) espoused that there are also associated savings ensuing from effective resource use, higher productivity and reduced risk. They argued that attention should be on finding ways of exploiting the benefits of sustainability for higher profitability. Other researchers have suggested that sustainable construction does not necessarily result in an increased capital cost when comparing preliminary capital cost, against operational costs of the facility (Sourani and Sohail, 2011; Dobson *et al.,* 2013).

2.4.8.2 PerceivedLuxury

Sustainability is relatively a new concept in the construction industry. Developments in the sector show that sustainability and sustainable construction are yet to form an integral part of decision making and business practice in the sector. For this and many reasons, Sustainable construction is still viewed as a luxury addition to regular practice, rather than a necessity or as the key stimulus driving business and development decisions (Reffat, 2004; Shafii, 2006).

2.4.8.3 Lack of Capacity

Lack of capacity has been identified as one of the most critical barriers confronting the construction industry in its quest to implement sustainable practices. This lack of capacity has been attributed to the number of human resources and the skill levels of these resources (Reffat, 2004).Other observations are that there are simply not enough professionals, tradesmen and labourers who have the requisite knowledge and skills to support sustainable construction at the various levels **(**Shafii, 2006; Reffat, 2004). The vast majority of construction firms, particularly in third world countries are small enterprises that depend on outsourcing workforces as needed. This scenario has seriously affected training and the retention of skilled personnel in the sector as the workforce becomes very movable, walking in and out of the sector, depending on the situation in other sectors of the economy. This phenomenon, coupled with the fact that sustainable construction takes time to materialise present a real time challenge to the industry (Reffat, 2004; Shafii, 2006).

2.4.8.4 Lackof Awareness and Understanding of the Concept.

Lack of awareness and understanding of sustainability issues in a holistic manner present a real time barrier to realising SC goals (Abidin, 2009; Plessis, 2002).

Sustainability is still a relatively new concept for many construction industries in the developing countries (Shafii, 2006) for this reason, many stakeholders (including senior

procurement decision-makers) lacks an appreciation of the concept of sustainable construction making them naturally unyielding to change. Hence, lack of understanding of the need for sustainable design is the greatest barrier militating against the concept (Shafii, 2006; DU-Plessis 2002; Sourani and Sohail 2010).

2.4.8.5 Lackof Integrated Research and Entrenched Colonial Codes and Standards

Creating a sustainable built environment in the developing world necessitates a different method from that adopted by the developed countries. However, this is not often well understood and discussed in some previously colonised third world countries. The scale of problems, the development priorities, the capacity of the regional and local industry and governments, as well as the skill levels found in developing countries are in most cases profoundly different from those found in developing countries. All of these aforementioned affect the understanding and application of sustainable construction in Ghana and other developing countries (Plessis, 2002).

In nearly every area of sustainability, further research and well-trained people, are required. Even though not everyone in academia can or should be focusing on these issues, there is however a need for academia to centre its attention more intensely on developing the requisite knowledge, tools and training required to combat the challenges of sustainable construction (Robinson, 2003).

2.4.9 Benefits of Sustainable Construction

The benefits that accrue from the adoption of sustainable construction practices include process and product paybacks. Process paybacks comprise material savings due to reuse, recycling, conversion of waste into useful forms, savings resulting from improved and safe working environment, and reduction of the costs of the activities associated with discharges, waste treatment, transportation, and minimal energy consumption during

operation. Product paybacks include higher construction quality, lower life cycle costs, and safer construction process (Baloi, 2003).

The major economic benefits of sustainable construction are reduced operation and utility costs, low maintenance cost, and general improvement in the buildings performance and efficiency. Research has shown that there is a direct and positive relationship between sustainable product and business competitiveness and highlighted that implementation of sustainable construction practice contributes to the improvement of contractors' competitiveness (Baloi, 2003).

It's been observed that sustainable interventions that were in the past considered expensive have actually proven to be cost neutral, and in some instances cost effective. A typical example is the sustainable urban drainage schemes, in which savings were made from the reduced costs of pipes and hard drainage (Plessis, 2002). Berry, 2008) also confirmed these economic benefits to constructing sustainable buildings siting energy cost savings, water cost savings and mechanical equipment slim down. Dobson *et al.,* (2013) also observed that the business benefits of sustainable construction come in the form of capital cost savings, reduction in running costs, higher investment proceeds, better productivity, staff recruitment and retention, more efficient resource use; better corporate image and marketing spin offs.

Halliday (2008) also cited some benefits that accrue to the Contractor.These includereducing waste, savings resulting from waste reduction, reduced time in making good environmental damage, reduced risk of legal costs (fines), better company profile, improved tender opportunities, reduced neighbour disputes and reduced demand for resources.

2.5 Summary

The construction industry has been under pressure to improve upon its operations in line with the principle of sustainability in what is now termed sustainable construction (SC). SC seeks to achieve environmental, economic and social equilibrium in the built environment. The call for SC is partly due to the negative impact resulting from the sector‘s operations such as high resource consumption, waste generation, environmental dereliction, negative social image, poor safety records among other factors. Whiles the developed countries are making headways in the implementation of sustainability in the construction sector, developing countries such as Ghana have not fully embraced the concept of SC. This phenomenon is attributable to barriers such as perceived high cost, lack of capacity, lack of awareness and understanding of the concept, perceived luxury addition to normal practice, and the lack of integrated research. Nonetheless, Ghana has the potential to achieve SC goals and the benefits thereof, which includes process paybacks such as material savings, product benefits including higher construction quality, lower life cycle costs, and safer construction process, major economic benefits as in reduced operation and utility costs, low cost of maintenance among others.

CHAPTER THREE

SUSTAINABLE CONSTRUCTION PROCUREMENT

3.1 Introduction

—Buildings and the way they operate have a fundamental impact on the environment, consume large quantities of resources, involve large numbers of workers, and represent

a large proportion of economic activity, so decisions made during all stages of the construction procurement process are vital for maximising sustainability.‖ (Boswell and Walker, 2004)

This chapter is dedicated to the review of the general and construction specific sustainable procurement literatures on the attainment of sustainable construction along the procurement route. Here,an attempt is made to make a case for procurement as a tool for realising sustainable construction goals through a demand driven approach. The author reviews literature about sustainable procurement developments and its implementation in the developed world, particularly the European Union, as well as in the developing world, in order to gain an appreciation of the concept and an insight into the overall implementation.

Key section reviewed in this chapter includes procurement and sustainable procurement, an overview of the procurement processes in the construction sector, sustainability and public procurement, the role of client and procurement entities among other subjects. In the end it is established through evolving literature that procurement provides an avenue for realising sustainable construction.

3.2 Procurement-A Tool for Achieving Sustainability

Whiles definitions for sustainable development abounds, it appears that there are not as much suggested approach for putting sustainability ideas into practice. This phenomena coupled with the varying ‗needs' between various groups makes the implementation of sustainability principles across various sectors more challenging (Belfitt*et al.*, 2011). However,Adetunji*et al.* (2003) point out that ―client's procurement policy‖ is one of the highest ranked drivers for implementing sustainability. Procurement is a demand driven approach to the realisation of needs and in economic terms demand influences supply

(Whelan and Msefer, 1996). It is therefore possible to achieve sustainability goals using procurement as a tool. In this literature and the various subsections to follow, we explore how this can be applied to sustainable construction.

3.3 Procurement vs. Sustainable Procurement

It can be argued that procurement and sustainable procurement are different. To begin with let‘s put the two terms above in context.

3.3.1 Procurement- Defining the Term

A general definition of the procurement term is that adopted by the construction industry board: _the act of obtaining by care or effort, acquiring or bringing about‘, (Walker and Rowlinson, 2008). A more detailed definition is proposed by The Chartered Institute of Procurement & Supply as ―*the business management function that ensures identification, sourcing, access and management of the external resources that an organisation needs or may need to fulfil its strategic objectives*‖ (CIPS, 2006). The source elaborating more on the above definition indicated that procurement is an explorative process that seeks opportunities within the supply market to implement resourcing strategies with the objectives of delivering an optimal supply outcome to an entity, its customers and stakeholders. Berry and Macthy (2011) defined procurement as ―the process of acquiring goods, works and services, covering both acquisitions from third parties and from in house providers.‖

Unfortunately, procurement has been linked (as synonym) to buying, contract management, supply management or supply chain management and purchasing just to mention a few (CIPS, 2006). While it is not within the scope of this work to distinguish in meaning or function between these terms, it is important to emphasise that all these other ―jargons‖ comes as a subset within the broader procurement activities and can

represent one or two steps in a much more complex process, all the more so in the construction sector which is the direction of this research (CIPS, 2006).

Procurement spans the whole series of activities from ***needs assessment***(identification of needs) for goods, works or service through to its ***disposal,*** (end of the useful life of an asset or end of a service contract)and includes activities and events before and after the signing of a contract (CIPS, 2006; ODPM, 2003).

These include:

- Pre-contract activities such as planning, needs identification and analysis, and sourcing,
- Post-contract activities such as contract management, supply chain management and disposal, and
- General activities such as corporate governance, supplier relationship management, risk management and regulatory compliance.

From the above consideration, it can be argued that procurement activities are at the core of organisational function and every decision taken along the procurement route impact directly on the operation of the organisation and by exertion stakeholders and the community at large. Procurement applies the science and art of external resource and supply management through a body of knowledge interpreted by competent practitioners and professionals.

At this juncture what remains to be seen is how this whole process is affected when it is preceded by the word ―sustainable‖.

3.3.2 Sustainable Procurement

Sustainable procurement is quite easy to define and there is less controversy among authors regarding its definition. The general agreement among authors is that sustainable

procurement is procurement that is consistent with the principles of sustainable development - the pursuit of sustainable development objectives along the procurement process - and involves balancing economic, environmental and social objectives (Walker and Philips, 2008; Walker and Brammer, 2009; Qiao and Wang,

2011). CIPS (2013) defines Sustainable procurement as ―*A process whereby organizations meet their needs for goods, services, construction works and utilities in a way that achieves value for money on a whole-life basis in terms of generating benefits not only to the organization, but also to society and the economy, whilst remaining with the carrying capacity of the environment*‖. According to walker and Brammer (2011), the concept underpinning sustainable procurement ensures a society living within environmental limits in good health, whiles promoting good governance that has the potential to reduce the environmental impacts of public sector organisations, and also benefiting society, the natural environment and reducing overall operating costs. Sustainable procurement also necessitates organizations to ―think outside the box‖ by considering activities outside its own boundaries (Belfitt*et al.*, 2011).

3.4 Public Procurement and Sustainability

Public procurement is concerned with how public institutions spend taxpayers‘ money on goods, services and works and is guided by principles of transparency and accountability, and aims at achieving value for money for citizens and taxpayers (Walker and Brammer 2009).

Governments all over the world have been using procurement as a policy tool to deliver wider government objectives, such as inspiring innovation in local markets, using state funds to augment environmental or social objectives, and for supporting domestic markets (McCrudden, 2004; in Walker and Brammer, 2009). A typical example is the Black

Economic Empowerment initiative in South Africa, instituted as a policy tool in the post-apartheid South Africa with the objective of prioritising public buying from black-owned businesses as a means to redress the economic advantages of white-owned businesses that came about as a result of apartheid (Walker and Brammer 2011).

Authors such as Qiao and Wang (2011), Mensah and Ameyaw (2011) have also recognized the use of procurement as an instrument of government policy and a lever for wider economic, social and environmental change, ranging from protecting local industries against competition from their multinational counterparts to the modern promotion of social equality. This phenomenon as noted by Mensah and Ameyaw (2011) provides for a broader view of procurement, particularly public procurement than just a business undertaking.

Today, public procurement has been called upon to get done another essential mission: to promote sustainable economic development and to protect environment (Qiao and Wang, 2011). At the World Summit on Sustainable Development in 2002, governments were tasked to "promote public procurement policies that encourage development and diffusion of environmentally sound goods and services‖ (WSSD, 2002). This and many such calls has prompted the drive towards sustainable procurement, making it a powerful means to inspire more sustainable consumption and production patterns for society at large (UN, 2008).

Some governments in the EU and UK have initiated significant responses in this regard (Walker and Brammer, 2011). In 2005, the government of UK stated as part of its goals to be among the leaders in Europe on sustainable procurement by 2009 (Walkerand Brammer 2011, Sitting DEFRA, 2005).

As McCrudden (2004: in walker and Brammer, 2011) notes, sustainability places government in two roles:

- By participating in the market as the single biggest customer within a country and
- Regulating it through the use of its purchasing power to advance conceptions of social justice and to influence the behaviour of private sector organisations, support environmental or social objectives, and for supporting domestic markets.

This sentiment is shared by other authors such as Plessis (2002) who assert that governments occasionally seek to achieve other domestic policy goals, such as the promotion of local industrial sectors while ensuring best value for money through an open and non-discriminatory procurement regime. Unlike the private firms who may pursue socially responsible procurement as a matter of choice rather than an obligation, to government procuring agents, sustainable procurement comes as a responsibility to society *(*Walker and Brammer, 2009).

It has been shown in many instances that, public entities make a lot of savings when sustainable procurement is pursued compared to a business as usual scenario (UN, 2008). There can also be desirable indirect effects accruing from public demand for more sustainable produced goods and services, such as creating awareness about the environmental and social repercussions accompanying different types of purchases. There is also the need for governments to lead the way by putting public procurement practices in line with their publicly advertised environmental objectives in order to promote more environmentally friendly consumption patterns among its stakeholders (UN, 2008).

Many countries in both developed and developing worlds have used public procurement to pursue sustainability goals. Table3.1 below presents typical examples in modern times across the globe.

Table 3.1 using public procurement to achieve sustainability goals- some country examples' source: (DESA, 2013; Defranceschi and Vida, 2007)

Sustainability Examples		
Country	**Policy**	**Beneficiary**
Switzerland	**Gender:**a requirement of equal pay between men and women made mandatoryfor all public contracts performed in the country	Women
Since 1996 in Canada	Specific contracts for which aboriginal populations are the primary recipients, procurement is to be restricted to qualified aboriginal suppliers	Indigenes
United States	Conditions requiring _affirmative action' in employment in government contracts are among the measures seeking to achieve greater equality for African-Americans	African-Americans
Sustainability examples (contd.)		
COUNTRY	**POLICY**	**BENEFICIARY**

United Kingdom	A provision known as ―Special Contract Arrangements‖ (SCA) necessitate contracting authorities to give special consideration to procuring goods and services from suppliers which employ severely disabled people	Disabled people
Malaysia	In order to encourage greater participation of the bumiputeras (indigenous Malays), tenders from bumiputera companies receive preferential treatment in government contracts.	Indigenous Malays
India	In India, procurement rules stipulate that certain goods must be purchased from small and microenterprises, even if prices are up to 15 percent higher than those offered by the competition	Small and microenterprises
Brazil	In Brazil, a new law in force since January 2007 establishes criteria that are meant to increase participation of smaller businesses in public procurement.	Smaller businesses and enterprises
City of Nantes, Franc	Including social clause for promoting employment: City of Nantes, Franc Extra points were awarded in procurement contracts for works (construction and renovation) and service contracts to bidders (companies) who demonstrated a voluntary commitment to allocate a higher number of working hours for unemployed people than required.	Unemployed youth

3.4.1 Public Procurement in Ghana

Reports show that public sector procurement in Ghana constitutes about 50 to 70 per cent of total national budgets, 24 percent of imports and contributes about 17 percent to Ghana's GDP (World Bank, 2003a; PPA, 2013). Implicitly, public procurement therefore has both social and economic impact on the country.

Public procurement in Ghana is guided by the public procurement Act, 663 established in 2003 to streamline the anomalies in public procurement (Osei-Tutu *et al*., 2011). The objective of the Act is to uphold fairness and transparency in the procurement process and to ensure that public sector procurement is non-discriminatory (Act 663, 2003). The Act defines public procurement as _the acquisition of goods, works and services at the best possible total cost of ownership, in the right quantity and quality, at the right time, in the right place for the direct benefit or use of governments, corporations, or individuals, generally via a contract' (Act 663, 2003; PPA Module, 2007). In another expression, public procurement is the process through which an organization acquires goods, works and services using public funds either fully or partially. It is a wideranging process that ranges from planning, allocation of budget, bidding, evaluation of bids, award of contract, contract management, performance measurement, and

monitoring, auditing and reporting as well as final disposal. In all, the Act can be said to be the framework within which the solicitation of tenders, evaluation of tenders, award of contracts, usage and disposal of goods, works and services can be done (PPA, 2013).

According to Osei-Tutu *et al.* (2011), the enactment of the act in 2003 was also to ensure that modern trends in procurement are adopted. However, the issues about sustainable procurement as a contemporary trend in procurement in not adequately addressed by the act (Mensah and Ameyaw 2011). A report on a ten year review programme of work on sustainable Consumption and production patterns in Ghana indicates that current

procurement is based on economic considerations while sustainability issues is conceived as a future prospect in public procurement.

Traditional procurement practices such as the one being pursued in Ghana issue undue emphasis on price considerations to the neglect of other vital consideration, a phenomenon that works against the pursuit of sustainable development goals (Shafii*et al.* 2006; Mensah and Ameyaw 2011). With the emergence of sustainability as a vital theme in the development agenda of nations comes the call for a paradigm shift in procurement system from immediate economic advantages to sustainable public procurement systems, which will result in long term benefit with the goal of reducing possible adverse effects(Mensah and Ameyaw, 2011).

Large organisations all over the globe have been seeking sustainable outcomes through their procurement undertakings. By incorporating sustainability principles and practices, procurement has the potential to reduce negative outcomes for society and the natural environment.

3.5 Procurement in the Construction Sector

Construction procurement constitutes an important activity within infrastructure delivery processes and occurs at various stages where resources external to the client are required (Shakantu and Kajimo-Shakantu, 2006). It may not be necessary to define construction procurement haven‘t define construction and procurement previously. Generally speaking, it is procurement activities within the construction sector. For the avoidance of doubt it will be worthwhile to put it in a better perspective (technically).

The European commission (2012) defines Construction procurement as ―the process of identification, selection and commissioning of the contributions required for the delivery of:

- Alteration, refurbishment, maintenance, extension or demolition of an existing building or structure, and/or
- The creation of a new building or facility, including all associated site works.‖

Construction procurement differs from the conventional procurement of goods and/or service in that a direct acquisition of a Building (unless it is a small prefabricated unit, for example a school classroom) is rare compared to procurement of goods which can be requisitioned, ordinarily 'off the shelf' and where a direct choice can generally be made almost instantly in terms of characteristic quality and also cost. The same argument can be made for an alteration or refurbishing an existing building which does not compare with the procurement of goods. Also new buildings are seldom standard and the refurbishment of existing buildings nonstandard. The entire Construction procurement activities as observed by Gronroos (2000, in Kadefors*et al.,* 2006) is characterised by a combination of services and tangible products.

Another factor that sets construction procurement far apart from the conventional procurement of goods and services is the degree of complexity involved in the process (CIOB, 2010). The procurement of a built asset encompasses commissioning expert services for the purpose of creating a specific solution. This is a real complex venture, involving the collaboration of the Client, design team, contractor(s) (who deliver the construction expertise, labour, materials and plant resources), suppliers and several statutory/public bodies (Construction Procurement Manual, 2011). Factors such as ground conditions, topography, logistics, weather, available technologies, finance, labour

availability and services, just to name a few, greatly affect construction procurement delivery (CIOB, 2010).

The collaboration between the construction procurement team and other professionals such as planners, architects of various specialisations, engineers of various fields and surveyors all in the quest to ensure that procurement procedures and documents facilitate the design intent marks another distinctive factor of construction procurement that cannot be overemphasized (Charvat, 2000).

The requisite Skill and knowledge for a successful procurement of a constructed facility is wider than the traditional procurement of goods. According to Charvat (2000), this skill or knowledge is usually acquired through practical experience in building management, design and construction and also general procurement processes. For projects that are wholly or partly funded with taxpayer‘s money or for some other reason heavily regulated, such as health care facilities that require state inspections or government procurements with minority-owned business enterprise participation requirements, there might be the need to comply with specific requirements and/or regulations. Under such circumstances, some clients may be require to seek outside help with specialist procurement consultants such as sustainability consultant (Sourani and Sohail, 2008; Charvat, 2000).

In summary a client may need construction procurement services in order to:

- Coordinate construction procurement without tying up in-house resources
- Obtain expert advice about selecting an appropriate project delivery method
- Obtain help in identifying qualified contractors
- Ensure that reasonable prices are obtained for construction work
- Assist in awarding and preparing contracts for construction

- Obtain a complete constructed assert and services (Charvat, 2000).

The construction procurement process is previewed in the section that follows

3.5.1 Construction Procurement - An Overview

The procurement of construction, a real complex venture, encompasses the commissioning of professional services, from the procuring entity, or from external sources (Akram*et al.*, 2012; Walker and Rawlinson, 2008). The process is an interaction between the client, design team and other consultants, contractors (who provide the construction expertise, labour, and logistics required), suppliers and other parties (Akram*et al.*, 2012). This process according to Cartlidge (2004) is at the heart of infrastructure delivery in both public and private sectors.

There are different procurement strategy employed in the construction sector and each strategy adopted has its own merit and goals, which ought to be carefully calculated by clients. Table 3.2highlights some of the widely adopted strategies and their distinguishing characteristics.

Table 3.2: Procurement Strategies in the Construction Industry (compiled by Author)

Procurement Method	**Main Characteristics**
Traditional Procurement	A two stage process in which the design work is usually separate from construction. The consultant(s)is appointed for design and cost control, whiles the contractor, appointed through a competitive tendering procedure, and is responsible for executing the works (Baiden, 2006; Davis *et al*., 2008).
Design and Construct Procurement	Contractor accepts responsibility the design and construction in a self-contained unit in which all the necessary design and construction expertise exist within one organisation that has the requisite resources to undertake any task that arises. Design and construct method provides for a faster start on site, and the close amalgamation of design and construction can result in more effective programming (Greenhalgh and Squires, 2011; Davis *et al*., 2008).
Management Procurement (Management Contracting)	The client appoints an independent professional team, and also engages the services of a management contractor. They will serve as adviser to the team at pre-construction stages, and during construction they will be responsible for executing the works using direct works contracts. The management contractor is engaged to only manage the works whiles the independent professional team delivers the work completely on subcontracting basis (Davis *et al*., 2008; Baiden, 2006).
Construction Management	The management contractor is selected and is paid a management fee to provide a central role of managing the project and in lending administrative support to the client. The main difference is that works contracts, are direct between the client and works contractor even though it is organised and administered by the management contractor (Davis *et al*., 2008; Greenhalgh and Squires, 2011).

Design and Manage	Under the design and manage procurement, the contractor is paid a fee to design and manage, and to assume responsibility for works contractors and also for the design team. Actual works execution is done by package contractors (Davis *et al*., 2008;Baiden, 2006).

3.7 The Role of Procuring Entity in Achieving Sustainable Construction

The procurement approach adopted and the potential of clients using procurement to influence progress towards greater contribution of the construction industry in the quest to achieve sustainable construction have been clearly recognised (Ofori, 2006). In Recent time, attempts have been made by procuring entities to incorporate sustainability requirement in the procurement of infrastructure works. A typical instant is found in the UK government strategy for sustainable construction in which procurement is listed as one of the _means‘ to achieve the _ends‘ of improved sustainability performance (Belfitt*et al.*, 2011; Plessis, 2003) By incorporating sustainability criteria into procurement policies and procedures, clients, private and public alike create anenabling environment for sustainable construction to thrive and to promote demand for sustainable construction products.

Ofori (2006) also observed that knowledgeable clients in recent times have influenced the process by which their buildings have been designed and constructed. Some of these measures as noted by Ofori (2006) include:

- Identification of sustainable construction targets such as reducing waste and pollution incidents, setting targets for recycling aggregates or enhancing biodiversity.
- Adopting sustainable construction principles
- Adjustment in appraisal framework and procurement practice to embrace sustainable construction objectives.

In their numerous discussions on sustainable construction programmes in several European countries, in which the procurement process features prominently, the Working Group (2001) observed that clients are now mindful of their obligation concerning the realization of sustainable construction and for that matter more and more public purchasers do, incorporate sustainable considerations into their procurement policy. The group reaffirmed the need for clients, especially public clients, to play a leading role in promoting sustainability in construction, and to measure and report their progress in promoting sustainable construction.

The Group recommends that:

- Clients should be encouraged to assess tenders on the basis of the most economically advantageous tender (MEAT), balancing price, quality and life cycle costs, for which the quality assessment criteria should include sustainability factors.
- The award of contracts on the basis of _concessions' linked to solutions on the basis of _facilities management' taking increased account of life cycle costs may have its advantages.
- Tenderers may be encouraged to come up with alternative technical solutions that take into account sustainability aspects.

In the following subsection we review the contribution of entities at the various stages (where possible) of the construction procurement process.

3.7.1 Needs Assessment

The work of conducting needs assessment to determine infrastructure and other services needed rest largely on the procuring entity (or clients). At this stage the entity decides on what to be procured. Needs should be defined in a functional manner, so as to furnish solutions to problems rather than creating one (DESA, 2008). The inclusion of social,

economic and environmental needs of the entity and the community at large is regarded crucial to delivering sustainable construction objectives (Defranceschi and Vidal 2008;Cartlidge, 2004). It is important to formulating the subject matter to capture the intended sustainability requirement of the contract. An example of how this is achieved is illustrated in figure 3.1

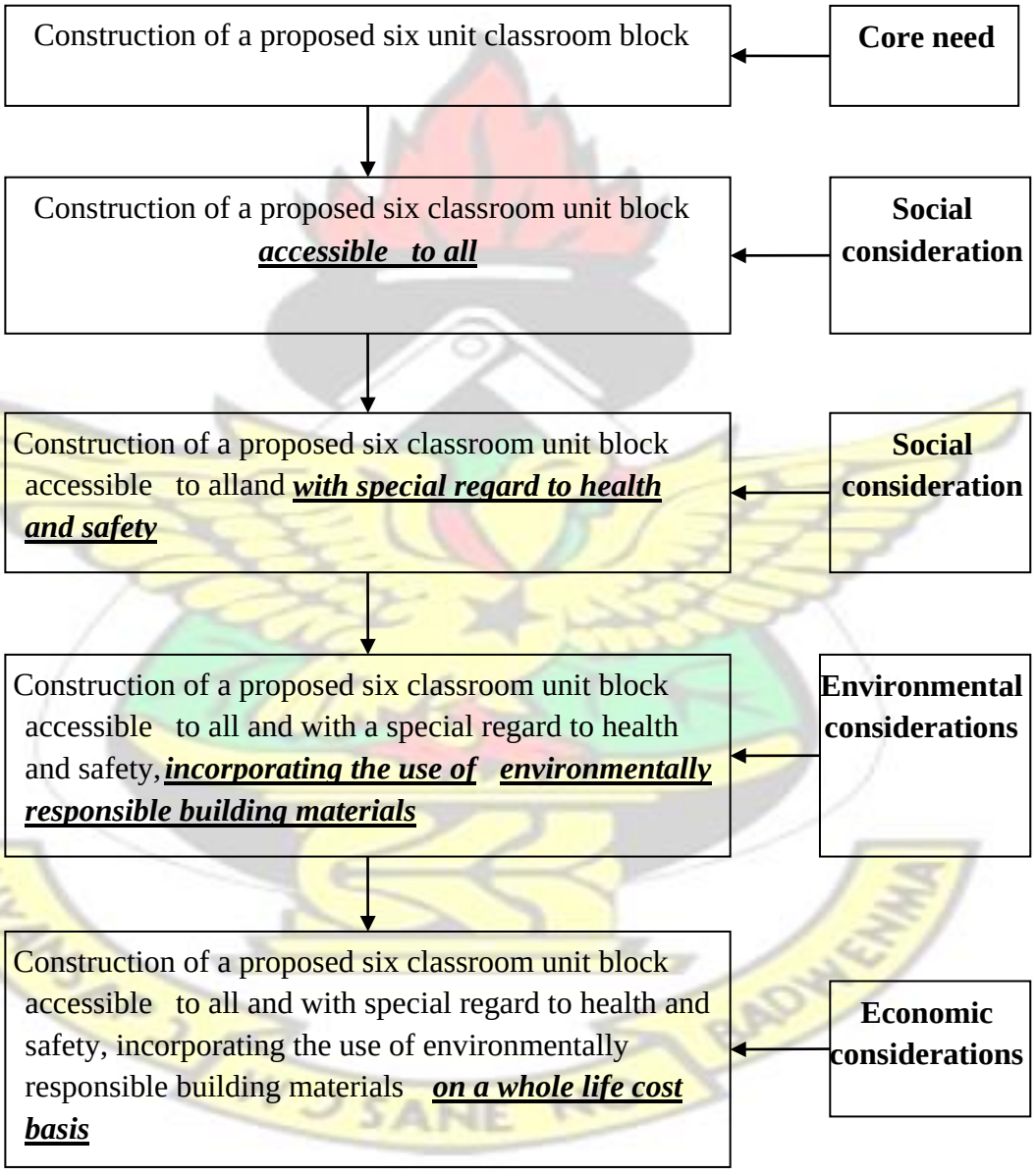

Figure 3.1: Defining subject matter in Sustainability terms (adapted from Defranceschi and Vidal, 2008)

3.7.2 Technical Specifications

The detailed information such as the quality, functionality and particular characteristics of a product or an asset to be procured is contained in the technical specifications. Also contained in the technical specificationare assessable requirements against which tenders can be appraised. Including sustainability criteria such as accessibility, public health concerns, etc., in technical specifications is a direct means to archive sustainable product (Defranceschi and Vidal 2008; Kjollerstrom 2008).

3.7.3 Award of contract.

This is the stage where offers that abide by the technical specifications are assessed and the most suitable one selected. Contracts can be awarded either by means of ―lowest price‖ or ―most economically advantageous offer‖. The latter preference gives room for criteria other than price such as sustainability criteria to be employed in deciding the best offer. The criteria should nonetheless be connected to the subject matter, measureable, weighted in relation to other award criteria, unambiguously defined in the tender and in accordance with local laws and international treaties (UN, 2013).

3.7.4 Contractual Obligation

Sustainability requirements can be present at all stages of the procurement process. However, such criteria becomes more binding when they form part of the contractual obligation in the definition of the subject matter of the contract, it‘s been observed. A typical instance is the contractual inclusion of community benefit clauses in the in procurement contracts (Defranceschi and Vidal 2008).

3.7.5 Track Records

Clients should evaluate the track record of both consultants and contractors in terms of sustainability during the procurement process. Tenderers may be required to submit documentscontaining the following information:

- A list of the accessible works carried out over the past five years,
- An indication of the specialised accessibility technicians or technical bodies involved,
- Possession of quality certifications and membership of qualification lists (assessed by certification bodies established under national public or private law)of approved economic operators undertaking public works, including accessibility,
- A description of the technical facilities and measures for ensuring quality and respect of accessibility criteria,
- The educational and professional qualifications of the persons who will be chosen to deliver the expertise required in the execution of the contract and A list of any relevant policies or code of practice regarding accessibility and / or —design for all‖ that has been put into practice (Defranceschi and Vidal 2008).

3.7.8 Enforcement and Monitoring

Another essential factor in ensuring that sustainability requirement is met is effective monitoring and measurement of actual delivery and the use of punitive measures for non-delivery. The procuring authority could implore a relevant target group (such as association of the disabled) at a predetermined stage of the project through to the completion of the building to undertake an accessibility check of the building. A negative finding will constitute a breach of contract for which punitive actions could be taken.

Products bearing specific labels that are presumed to conform to the technical specifications concerning the sustainability of a product could also be monitored (Defranceschi and Vidal, 2008).

3.8 Summary

It has been established throughout this chapter that the goals of SC can be realised by adopting a sustainable procurement approach in which the process of acquisition of an asset or product is used to deliver Sustainable Construction objectives. This is particularly the case for public procurement given that Governments all over the world have been using procurement as a policy lever to deliver wider government objectives, such as inspiring innovation in supply markets, using state funds to augment environmental or social objectives, supporting domestic markets, protecting national industries against foreign competition and to promote social equality.

Nonetheless procurement systems and laws in Ghana do not adequately embrace this important concept making the attainment of sustainable construction objective less attractive for both private and public entities alike. There is, therefore, a need for a shift from the traditional procurement approach to a more sustainable oriented approach if the objectives of a sustainable construction industry are to be realised at all.

CHAPTER FOUR RESEARCH METHODOLOGY

4.1 Introduction

This research aims at exploring means of achieving sustainable construction along procurement route in the Ghanaian construction industry. In chapters two and three, a critical review of rich contemporary literature on the subject matter was undertaken with the objective of gaining insight and to put the research into a broader perspective. Furthermore the literature review section also provided relevant hands-on secondary data for the conduct of the study.

This chapter addresses the logical choices available in research methodologies which enable the drawing of correct inferences to answer the various research questions presented under section 1.5. It starts with an overview of research paradigms and the various philosophical considerations as fundamental beliefs that affect the ways to conduct research. The chapter then details the research approach and discusses the various elements included in it. Such elements, includes, research method and technique, study setting, units of analysis, sampling techniques, etc. The different methods and techniques used in data collection are also outlined. These include questionnaire survey and semi-structured interviews. The chapter also defines the criteria for assessing the research approach adopted for the study, qualitative research, and shows how it was considered. Finally, the chapter introduces the strategy of triangulation and highlights its application in this research.

4.2 Philosophical Dimensions of Research

Ontology and Epistemology are the two main philosophical dimensions that distinguish existing research paradigms (Saunders, Lewis and Thornhill 2009; Kalof, Dan, and

Dietz 2008; Laughlin, 1995). Ontology relates to the nature of knowledge and what can be known about it (Guba and Lincoln, 1994). In other words, it is the researcher's answer to the question _What is the form and nature of reality and what can be known about it?' Epistemology has to do with the theory of knowledge, how it is generated, understood and its use (Wahyuni, 2012; Grix, 2002).

4.2.3 Philosophical Position Underpinning this Research

Ontologically this research adopts the *objectivist* position which espouses the nature of reality to be external and objective independent of what people make of it**(**Wahyuni 2012, Grix, 2002). This stance is evident in the fact that sustainable construction practice is vital for the survival of both current and future generations, giving the carrying capacity of the earth, even though there is a lack of understanding of this reality among many stakeholders. Furthermore, there exist means within the procurement process which can be explored to realise sustainability goals in the construction industry through the adoption of well-structured procurement practices and system which look beyond short term economic gains.

Epistemologically, the researcher believes that by adopting a scientific approach, it is possible to collect data and analyses them free from any form of bias to address the issues which are the main subjects of this research(Yavuz, 2012). This is possible irrespective of the varied backgrounds of the stakeholders. Hence epistemologically this research is aligned with the positivist's school of thought.

4.3 Research Approach

There are two main approaches to conduct of research: **quantitative** and **qualitative** research approaches. A third approach **mixed method,** also known as Pragmatic approach

(Fellows and Liu, 2008) resides in the middle of this continuum because it incorporates elements of both qualitative and quantitative approaches (Creswell, 2009).

Factors that affect the choice of any particular approach identified above include:

- The philosophical assumptions the researcher brings to the study (see section 4.2) The procedures of inquiry (also known as research strategies or research method) Chosen data gathering method, analysis, and interpretation.
- The forms of the research problem or topic being addressed, the researchers' own experiences, and the audiences for the study. (Creswell, 2009).

The research approach adopted for this study is discussed under section 4.3.3

4.3.1 Quantitative Research

Quantitative approach uses scientific method in which preliminary study of theory and literature produces specific aim and objectives with proposition(s) and hypotheses to be tested and then verifying or modifying the hypothesis on the basis of the research findings (Phillimore and Goodson, 2004). It also involves the use of mathematical techniques and predetermined instruments that yield statistical data to produce quantified conclusions (Bell, 2005; Creswell, 2003) and the generalisation of findings to the entire social world (Guba and Lincoln, 1998; in Phillimore and Goodson, 2004).

By its nature, this approach, as noted by Mack *et al.* (2005) is fairly inflexible as its study design is stable from beginning to end. Quantitative researchers as noted by Creswell (2003) and Denscombe (2007) adopt positivist assertions for developing knowledge and also employ strategies of inquiry such as experiments and surveys. Accordingly, quantitative researchers have often sought to abstract the phenomenon that is being studied from the rest of the social world and to fix meaning within what might be

described as a contextual vacuum (Phillimore and Goodson, 2004). Generally, quantitative approaches provide _snapshots‘ and so, are used to address questions such as what, how much, how many? Thus, data and result are instantaneous or crosssectional (Fellows and Liu, 2008).Naoum (2002) concluded that quantitative research strategy is selected for:

- Finding facts about a concept, a question or an attribute; and
- Collecting factual evidence and study the relationships between the facts in order to test a particular theory or hypothesis.

4.3.2 Qualitative Research Approach

Qualitative research is characterised by its aims, which seek to gain insights and to understand people‘s perceptions of _the world‘ – whether as individuals or groups by investigating the beliefs, understandings, opinions, views, etc. of people (Fellows and Liu 2008; Berg, 2001) and its methods which (in general) produce words as data for analysis, as opposed to numbers (Brikci and Green, 2007; Mack *et al*., 2005). The data gathered in qualitative approach are mostly unstructured, making analyses of such data much challenging as compared to quantitative data analysis (Fellows and Liu, 2008). Interpretation of observed phenomena is greatly emphasised in the constructivist/interpretivistformat (Creswell, 2009; Denscombe, 2007), thus making the data and result more susceptible to external, environmental variables and the researcher‘s intimately involvement at all stages of the work in a more active way than usually is acceptable in quantitative studies (Fellows and Liu, 2008).

Qualitative approaches to the collection of data, analysis and interpretation, vary from the conventional, quantitative approaches. Purposeful sampling method, collection of open–ended data, analysis of textual or pictorial data, presentation of data in figures

and tables, and individual interpretation of the result all characterise qualitative research approach (Creswell 2009).

A qualitative research strategy may be adopted when:

- There is no existing research data on the topic and the most appropriate unit of measurement is not certain; and
- The concepts to be researched are assessed on a nominal scale, with no clear demarcation and involve exploring behaviour or attitudes.

4.3.3 Chosen Research Approach

The study which aims at ―*Exploring means of achieving sustainable construction along procurement route in the Ghanaian construction industry*‖ is based on Qualitative research approach which explores the general perception and opinions ofa population by means of a representative sample (Fellows and Liu 2008; Berg, 2001; Mack *et al.* 2005). Furthermore data was gathered through methods such as semi-structured interviews and questionnaires which generate soft, descriptive and less structured data that is analysed using non-statistical techniques all of which characterises quantitative research approach.

The chosen research method and data collection procedures are discussed in details under sections that follow.

4.4 Research Methods and Techniques

Research method according to Jankowicz, (1991) cited in Sourani (2008) is "*a systematic and orderly approach taken towards the collection of data so that information can be obtained from those data*‖. Among these are surveys, archival analysis, history experiments, and case studies. Techniques, as distinct from methods, are ―*particular, step by step procedures which one can follow in order to gather data, and analyse them*

for the information they contain‖. In further support to the argument espoused by Jankowicz cited above, Vanderstoep and Johnston (2009) asserted that Methods define the focus of the study whiles techniques, such as interviews, focus groups, etc. and can be used across a number of different methods.

There are several research methods. Bell (1993,cited in Fellows and Liu, 2010) suggests research methods to be Action, Ethnographic, Surveys, Case Study and Experimental. Yin (1994, cited in Sourani,2008) suggests that the determination of the most appropriate style to adopt depends on the type of research operation (what, how, why, etc.), the degree of control that the researcher can exercise over the variables involved and whether the focus of the research is on past or current events. The requirements of the major research styles are set out in Table 4.3.

Table 4.1 Relevant Situations to Different Research Approach (Source: Yin, 1994; in Sourani, 2008)

Research method	Type of research question	Requires control over behavioural events?	Focuses on contemporary events?
Experiments	how, why	Yes	Yes
Survey	who, what, where how many, how much	No	Yes
Case study	how, why	No	Yes

Archival Analysis	who, what, where, how many, how much	No	yes/no
History	How, why	No	No

4.4.5 Chosen Research Method

The research method adopted for this study is based partly on the framework proposed by Yin (1994) in Table 4.1. This leads to the adoption of the survey method (involving both interviews and questionnaire survey).

Survey is employed to address research questions 1, 2 and 3:

- What are the key factors in the procurement process that aids in achieving sustainable construction?
- What are the criteria for assessing sustainable construction at the various stages of the procurement process?
- What role do procurement entities have to play in achieving sustainable construction procurement?

According to Yin (1994) the "form of research question" is the first and most important condition to distinguish between the different methods (see table 4.1 above). Evidently Survey and Archival analysis appropriately addresses the ―what‖ operation in the questions above. Furthermore, the two research methods aforementioned satisfy the second conditions in table 4.1 above in that there is no control over behavioural. The third factor to consider when deciding on an appropriate method is the degree of focus on contemporary events. Once again, all but History will be applicable under the third

consideration. Archival analysis is not considered a viable option in that it could also be used for a retrospective study as indicated by the yes/no entry under the third consideration column in table4.4. According to Sourani (2008) archival analysis is much favoured when there is no focus on contemporary events. Hence and for the avoidance of doubt Survey seems the best option.

4.4 Data Collection Instrument

The data collection methods or techniques formed an important part of this research. According to Patton (2002) employing two or more data collection instrument reinforces and lends credibility to the study. Furthermore employing more than one data collection instrument depicts the true picture of the case under study. In this regard, two different instruments, namely questionnaire survey and interviews were employed to collect the required data. This approach revealed issues that could not be raised using only one data collection instrument.

The study employed both primary and secondary sources of data in order to gather relevant information for the study.

3.4.1 Primary Data

The primary data collection instruments were questionnaires and interviews. The data were collected from the selected respondents in the research population. The analysis of the study is based on this data.

3.4.2 Secondary Data

The research made reference to various publications of local and foreign origins, including articles and journals, books, reports obtained from libraries, PPA, Public Entities, the internet, etc. These sources provided additional information on the subject matter that aided in finding answers to the questions set in the problem definition.

4.5 The Study Area

The study was conducted in the Western Region of Ghana. The area consists of stakeholders in the construction industry. These include client/procurement entities, Architects, Quantity Surveyors, Civil, Mechanical, and Electrical Engineers etc. within the western region.

This region is strategically located in the south-western part of Ghana. It covers an approximate land area of roughly 2, 3921 square kilometres, which amounts to about 10 percent total land area of Ghana. Western region shares boundaries with three other political regions of Ghana, Ashanti in the northeast, BrongAhafo Region in the north and Central region in the east. The region also shares border with Ivory Coast in the west and the gulf of Guinea to the south. The population of the region is 1,924,577, which comes up to about 10 per cent of the national population of Ghana (GSS, 2005). The western region has Takoradi as its capital.

Agriculture, mining, trading and related work are the major occupation within the study area, though the level and intensity of a particular occupation vary from one district to another.

4.5.1 Construction Activities in the Study Area

The region has witnessed a tremendous increase in construction activities over the last decade in terms of roads, commercial and domestic buildings just to mention a few. The situation is partly as a result of the increase in population in that part of the country, partly due to the oil find and the springing up of petrochemical and its auxiliary industry. This situation, coupled with Ghana‘s fast growing economy has given rise to an ever increasing demand for infrastructural development like never before, to adequately meet the

infrastructural and housing demand for the region and its growing economy in general as well as the petrochemical and its auxiliary industries.

While this present great news for the players in the construction industry in terms of job opportunity and commerce, this phenomenon has the potential of over utilisation of non-renewable resource not to mention the environmental and socioeconomic impacts.

To mitigate the negative effect of these phenomena, there is the need for a conscious effort towards sustainability, which seeks to build on a shared commitment to procure in a more sustainable way and focuses on promoting the business case for better procurement practices in the construction industry (WGSC, 2008).

4.6 Population and Sample

A research population can be defined as the totality of individuals or objects that have a common, binding characteristics or traits. The population for this study consist of professionals involved in procurement of works within the scope of construction activities in the western region. These are the category of people whose activities directly or indirectly have a bearing on the realisation of sustainability within the construction sector. They include Construction clients, Procurement professionals in both public and private institutions (including MMDAs, education institutions, health centres,etc.) main contractors, subcontractors, project managers, construction managers, suppliers, designers and architects, environmental and sustainability consultants, civil engineers, structural engineers and building services engineers, researchers and students of construction and related discipline.

One of the challenges encountered in this exercise was determining the population size. This is as a result of the highly mobile nature of construction professionals and given that most of these were expatriates (Dainty*et al.*, 1998). Also, most of these professionals

move in and out from other regions in the country. It becomes difficult to know the exact population of construction professionals at any particular time operating in the study area. Furthermore, checks at the regional offices of the Ministry of Water Resources, Works, and Housing yielded no data in terms of the population of professionals in construction and allied fields in the study area as of September, 2014. In view of the aforementioned challenges, sample size for the study was determined by the method of proportion (see Section 4.6.1.1).

4.6.1 Sample and Sampling Technique

In conducting a research study, it is extremely difficult, time laden and very expensive to use the entire population. Therefore, a smaller representation of the population known as unit sample is often used to represent the relevant attributes of the whole of the population (Graziano and Raulin, 1997).The logic of using a sample of subjects is to make inferences about some larger population from a smaller one, the sample (Berg, 2010; Chin and Lee,2008).

4.6.1.1Sample size determination

There are several methods for determining the sample size for a proposed research. These include the use of formula, published tables, by census for small populations, by adopting a sample size from similar studies and through the use of proportion(Israel, 2013).

The sample size for the survey was determined using a statistical formula. The needed sample size for a given population, according to Maisel&Persell (1996), can be estimated using Equation 4.1, where (n) represents the appropriate sample size for the survey.

$n = (Z \times \square/\text{Confidence Interval})^2$……Equation 4.1

Employing Equation 4.1, (n) can be deduced by establishing the confidence interval, the Z-value and the estimated standard deviation (Naing, et al., 2006). However, the standard deviation is unknown given that data has not been collected. In such a scenario, where the standard deviation is unknown, an approximate sample size can be estimated using expected proportions (P) (Maisel&Persell, 1996). P refers to the number of cases in any given category divided by the total number of cases (Ahadzie, 2007).

Given that there is no experience to apply to, the extreme case scenario with the P-value of 0.5, halfway between, which will yield the largest standard error, was considered (Ahadzie, 2007; Israel, 2013). This requires selecting the largest possible sample size (Israel, 2013). Therefore, the population standard deviation (S.D.) was estimated using Equation 4.2.

$\sigma = \sqrt{[P\ (1-P)]}$……..……..…Equation 4.2

Hence, standard Deviation, SD is calculated as follows

$$\sigma = \sqrt{[0.5(1-0.5)]} = 0.50$$

Therefore, at confidence limit of 95 %,

$$P = 0.50,\ Z = 1.96$$

For a confidence interval of $\pm$**0.1**, n is calculated as follows:

2 n=

(1.96 x 0.50/0.1) = 96

From the above result, a sample size of 96 would be required to obtain a normal distribution of the sample. However, in a similar study carried out by Sourani (2008), a total of 132 questionnaires were completed and returned.

According to Rumsey (2011) the size (n) of a statistical sample affects the standard error for that sample because n is in the denominator of the standard error formula and so the standard error decreases as n increases. Comparing the two figures above and choosing the higher value makes for the purpose of reducing the standard error. Hence

132 was adopted.

Again, thirty (30) percent was added to the estimated sample size to cater for nonresponses as suggested by Israel (2013). Therefore, a sample size of one hundred and seventy two (172) was used.

4.6.2 Sampling Technique

Denscomb (2009) identified two kinds of sampling techniques that can be used by researchers: _probability‘ sampling and _non-probability‘ sampling. Probability sampling is the notion that the people or events that are chosen as the sample will be a representative cross-section of people or events in the whole population being studied. However, statistical representativeness is not the rationale behind sampling in qualitative research as argued by Brikci and Green (2007). Hence,non-probability sampling techniques are employed in qualitative studies.Table.4.4highlights some of the non-probability techniques used in qualitative research.

Table 4.2: Non-Probability Sampling Techniques. (Source: Mack et al., 2005; Creswell 2009; Brikci and Green 2007).

Technique	Description
Purposive Sampling	Groups participants usingpredetermined criteria relevant to a particular research question. Purposive sample sizes are often determined on the basis of theoretical saturation (the point in data collection when new data no longer bring additional insights to the research questions).
Quota Sampling	In quota sampling, decision is taken while designing the study on how many people with which characteristics to include as participants. Features might include age, gender, place of residence, class, marital status, profession among others. The criteria are then used to choose people who would be most likely to experience, know about, or have insights into the research topic. This then forms the basis for recruitment strategies
Table 4.2 contd.	
Snowball Sampling	Snowballing is considered a form of purposive sampling. In this method, participants with who contact has already been made use their social networks to refer the researcher to other people who could potentially participate in or contribute to the study. Snowball sampling is often used to find and recruit ―hidden populations,‖ that is, groups not easily accessible to researchers through other sampling strategies
Convenience Samples	This category of sample relies on available subjects-those who are close at hand or easily accessible. For example, professors using their students as subjects in their research projects. It is an excellent means of obtaining preliminary information about some research question quickly and inexpensively
Cluster Sampling	Cluster sampling is ideal when it is impossible or impractical to compile a list of the elements composing the population

4.6.3 Sampling technique adopted for the study.

Purposeful sampling technique was adopted for the study. This enabled the researcher to select people who could provide the best information given what is already known about the research topic, and about the range of issues being studied as instances that are likely to produce the most valuable data. Furthermore, it allowed the researcher to home in on people or events which were good grounds for believing would be critical for the research. Instead of going for the distinctive examples, a cross-section or a balanced choice, the researcher was able to concentrate on instances which displayed a wide variety to illuminate the research question at hand.

4.7 Questionnaire Design and Administration

The Questionnaire developed by the researcher was subjected to review by some experts in academia as well as selected construction professional in a pilot test. Potential ambiguities in the questionnaire were identified and eliminated. Generally, the questionnaire was designed to collect general data from the stakeholder in the construction industry. These questions were grouped in categories to collect data in addressing the research questions.

4.8 Data Analysis and Validation

4.8.1 Data Analysis

Data analysis is the process of reducing large amounts of collected data to make sense of them (Kawulich, 2003). Qualitative data, according Taylor-Powell and Renner (2003) consist of words and observation rather than number. These, they argued further, require analysis and interpretation to bring to order and interpret using a systematic approach.

In this research analysis was carried out in order to make sense of the data collected so that appropriate interpretations could be generated to address the various research questions. Figure 4.1 outlines the steps adopted for data analysis.

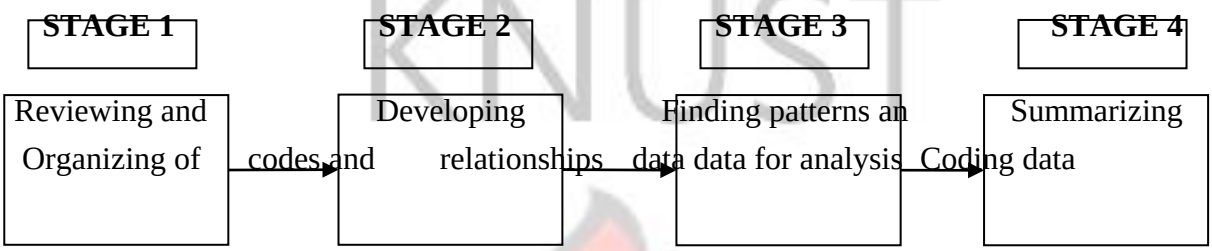

Figure 4.1: Stages in Data Analysis Adopted in the Literature

4.8.1.1 The Process of Identifying the Agreed set of Factors

The survey questionnaire was prepared to determine the relevance (or importance) and the extent of agreement among respondents regarding the sets of factors gleaned from literature in achieving objectives 1,2 and 3. Respondents were required to rank these factors on a 5-point scale ranging from 1 denoting "not important" to 5 denoting "extremely important", to indicate the relevance of these factors in satisfying the research objectives (see appendix A and B).

A consensus-based method was adopted in determining the relevant factors in each case. According to Jones and Hunter (1995, p. 376), the aim of consensus methods is "to determine the extent to which respondents agree on a given subject. Consensus can be measured using different indicators such as the percentage of respondents agreeing on certain factors (*c.f*: Green and Price, 2000; Hughes, 2003; Reetoo*et al.*, 2004; Padel and Midmore, 2005; and Sourani, 2008), standard deviation values (examples include Scholl *et al*, 2004; Feret and Marcinek, 1999; Miller, 2001 and Outhred, 2001) and the mean score (Sourani, 2008).

In the light of the above and based on the scale values used in the surveys, a factor is considered relevant if it satisfies the following conditions:

1. *Mean value*: a factor must score a mean value of not less than 3 (see column 4 in Table5.5). Given that a value of 3 represents important on the five point scale used, it is reasonable to conclude that a mean value which is less than three is less important and for that matter considered irrelevant;
2. *The Percentage of respondents agreeing on a factor*: Percentage of respondents agreeing on a factor as relevant must not be less than 75 percent (in other words the cumulative percentage of respondents scaling a factor below 3 must not exceed 25 percent); and
3. *Standard deviation values*: Standard Deviation indicates how widespread the variables are from the mean. It therefore shows the extent of agreement on a factor. For the purpose of this study an SD of 1.2 or less is desirable. (*c.f.* Sourani, 2008)

4.8.2 Data Validation

One of the ultimate goals of every researcher is to design a study that has strong internal and external validity and reliability, and a comprehensive multi-perspective view (Thurmond, 2001; Boyd, 2000). To achieve these set goals,a researcher conducts what is commonly known as data validation. Whiles there are several approaches to datavalidation,triangulation appears most common in recent times.

Dipeolu (2010) identified methods used which include:

- Triangulation
- Saturation
- Member checking
- Self-disclosure (Reflexivity)

In its simplest term triangulation refers to a process by which a researcher verifies findings by showing that independent measures of it agree with or, at least, do not contradict it (Miles and Huberman, 1994; cited in Meijer, Verloop and Beijaard, 2002). It involves an amalgamation of more than one theory, data sources, methods or investigators, etc., in the study of a single phenomenon to converge on a single construct (Yeasmin and Rahman, 2012). Olsen (2004) argued that triangulation do more than validates but also widens and deepens one's understanding. He defines triangulation as ―the mixing of data or methods so that diverse viewpoints or standpoints cast light upon a topic‖ Triangulation also extends the scope of theory, particularly in construction management research (Love *et al*., 2002) and thus offers the opportunity to cancel the limitations of one method by using another to crosscheck the findings (Bryman and Bell, 2003)

Several types of triangulation techniques have been identified. Table 4.5 summarizes the different triangulation techniques available in research.

This research adopted data triangulation for the validation purpose which was achieved in two folds:

- Through the use of multiple source as in the collection of primary and secondary data discussed under section 4.4
- Through the use of more than one data collection instrument, Questionnaire survey and interview, within the chosen research methods (see section 4.4)

Table 4.3: Triangulation Techniques (Source: Thurmond, 2001; Hussein, 2009)

Triangulation Technique	**Main Characteristics**

Methodological Triangulation	The use of more than two methods in studying the same phenomenon under investigation. This type of triangulation may occur at the level of research design or data collection.
Theoretical Triangulation	Involves the use of multiple theories or hypotheses in examining a phenomenon. The objective is to conduct the study with multiple lenses and questions in mind, to lend support to or disprove findings.
Investigator Triangulation	The use of more than two researchers in any of the research stages in the same study. It comprises the use of multiple, interviewers, observersor data analysts in the same study for confirmation purposes
Data Triangulation	Also referred as data sources triangulation, this depicts the use of multiple data sources and several sampling strategies in the same study for validation purposes

CHAPTER FIVEDATA ANALYSIS AND RESULTS

5.1 Introduction

This chapter presents and analyse the data resulting from the questionnaire survey. The survey was carried out in two parts. The first part of the questionnaire survey led to the development of an agreed set of sustainability factors that aid in achieving sustainable construction through procurement in the Ghanaian construction sector (objective 1 of the research) and in determining an agreed set of criteria for assessing SC along the three arms of sustainability i.e. Environmental, social and Economic criteria (objective 2 of the research). Further validation in relation to these findings was carried out (as discussed under section 5.4) through semi- structured interviews with experts in construction

procurement and in comparison with data gleaned under the literature review section. Section 5.2 presents detailed discussions on the first part of the survey.

Part two of the questionnaire survey identified, for the accomplishment of objective 3,to find the role of procuring entities in achieving sustainable construction. Findings from part two were validated accordingly through semi structured interviews with experts in construction procurement. Section 5.3 presents detailed discussions on the second part of the survey.

Findings from the two surveys together with information gleaned from literature ultimately led to the development of a conceptual framework (objective 4 of the research.) presented under section 6.3.4 for implementing, monitoring and evaluating
SC along the procurement route so that the goal of SC could be realized (research aim) Figure 5.1 shows the flow chat about how the various objectives and aim are achieved.

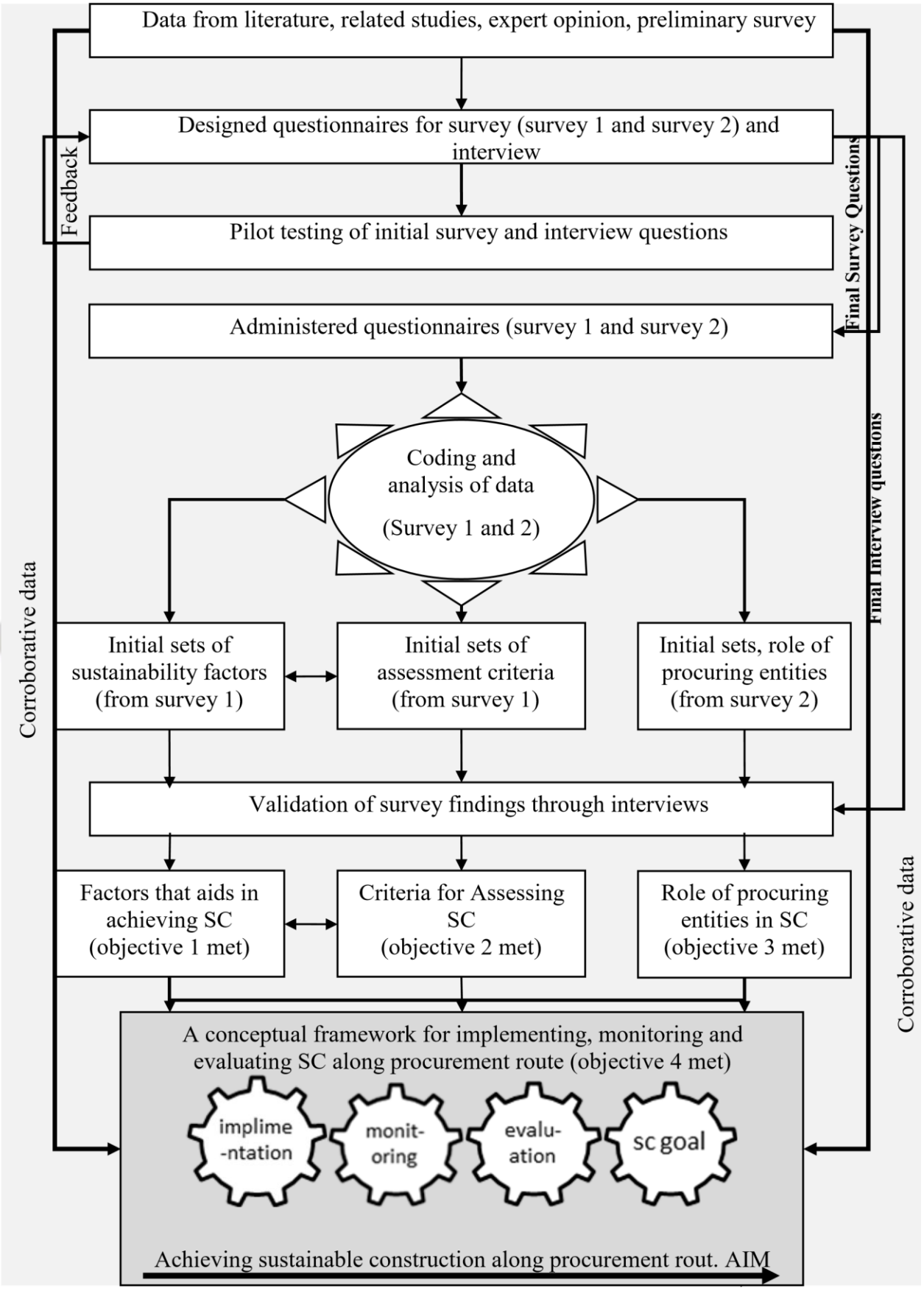

Figure 5.1: Towards Achieving the Research Aim and Objectives

5.2 Questionnaire Survey-Part One

Contents

As discussed in the previous section the questionnaire for the first part of the survey was to elicit information from professionals in construction procurement and allied fields on factors that aid in achieving sustainable construction procurement and the criteria for assessing sustainable construction. The questionnaires were sent together with substantive information about the research, the aim and concise definition of major keywords to enable respondents to appreciate and answer the questions rightly. Respondents were also given the opportunity to comment and make recommendations on any of the items in the questionnaire. Finally respondents were assured of their anonymity and that information provided will only be used for the research project purposes.

Responses A total of 172 questionnaires were distributed to professionals who are actively associated with the construction procurement activities and possessing sufficient experience in the field of construction. A total of 146 questionnaires were completed and returned (representing a response rate of 85 percent) out of which 136 was found eligible for analysis. The questionnaire was categorized into three sections as discussed in the subsections that follow.

5.2.1 Section A-Respondent's Background

This section of the questionnaire wasdesigned to capture respondents' background information specifically academic background, area of expertise, the nature of the establishment and relevant years of experience in construction procurement and allied fields. This information is necessary in assuring the reliability of the data obtained given that their background may affect their understanding and interpretation of the questions.

Respondents should have enough information or expertise, the experience and requisite knowledge to answer the questions truthfully. In all, 136 responses were analysed with no missing data in any of the categories.

5.2.1.1 Respondents Educational Background

The nature of the research required respondents of medium (certificate and diploma holders) to higher (degree holders) educational background in relevant fields of studies who are deemed well informed to give their opinion on the subject. The number and percentage of respondents belonging to each category are shown in Table 5.1. From the results obtained, it could be observed that 60per-cent of the respondents are degree holders (first degree or higher) and 27 percent being undergraduate. Together, these three categories of respondents represent 87 percent.

Table 5.1: Respondents' Education Background. (Source: Survey Data)

Qualification	**Undergraduate**	**Graduate**	**Postgraduate**	**Other**	**Total**
Frequency	36	55	26	19	136
Percentage	27	40	19	14	100

5.2.1.2 Professional Expertise of Respondents

The number and percentage of respondents for the various categories is presented in Table5.2. The result shows a fair representation across the key professions in the sector and guarantees diverse views on the subject matter.

Table 5.2: Professional Expertise of Respondents.(Source: Survey Data)

Category	Engineers (various fields)	Architect/ Designers	Quantity Surveyor/ Estimators	Consultants (various fields)	Others	Total
Frequency	41	18	35	6	36	136
Percentage	30	13	26	4	27	100

5.2.1.3 Nature of Establishment Respondent Works Under

Professionals in the construction sector works under different establishments and institutions in both public and private sectors. Diversification inopinionis therefore, necessary so that differences in opinion could be brought to bear on the subject matter.This part of the questionnaire seeks to establish the extent of diversification amongst the different establishment categories and its implication on the research findings. The result, presented in Table5.3, shows a fair representation across the different establishment categories. Diversification and balanced opinion could be expected.

Table 5.3: Respondents' Establishment Category.(Source: Survey Data)

Cat.	Construction consultancy and related services	Bldg./civil construction and related works	Think-tank, research and academic institutions	Public institutions (MMDAs, MDAs, etc.)	Other	Total
Freq.	23	38	21	30	24	**136**
Per.	17	28	15	22	18	**100**

5.2.1.4 Respondents'Years of Experience

Given the central role experience plays in the acquisition of knowledge (Kolb, 1984) the significance and potential of it has to be fully recognized (Hansen, 2000). The survey therefore, sought to explore the experience level of the respondents. The result is highlighted in Table 5.4. The result shows a high level of experience among the respondents generally. An insightful opinion could, therefore, be expected.

Table 5.4: Respondents' Years of Experience.(Source: Survey Data)

Category	**Up to 5yrs.**	**6–10 yrs.**	**11-20 yrs.**	**21–30 yrs.**	**Over30 yrs.**	**Total**
Freq	28	26	43	25	14	136
Per.	21	19	32	18	10	100

5.2.2 Section B-Developing agreed set of factors that aid in achieving Sustainable Construction

This section presentand discusses the findings of the survey in relation to determining factors in the procurement process that aid in achieving sustainable construction (objective 1 of the research). The analysis of the results, as presented under Section 5.2, led ultimately to the development of sets of 12 sustainability factors in the procurement process. The process of identifying and validating these factors are also presented under this section.

5.2.2.1 The Process of Identifying the Agreed set of Factors that Aids in Achieving SC(Sustainability Factors)

The survey questionnaire was prepared to determine the relevance (or importance) and the extent of agreement among respondents regarding the sets of sustainability factors gleaned from literature that aid in achieving SC along the procurement route in Ghana(14 factors - FI to F14).

Table 5.5 shows data obtained in this exercise. The first column under the table, labelled code, represents the unit codes generated for each sustainability factor as it appears in the questionnaire (see appendix A). These codes are maintained throughout the literature for references only. The second column shows the five point scale used in the exercise and under each scale the frequency**(f)** and the corresponding percentages**(%)** obtained for each factor. The last column, labelled mode, shows the scale value with the highest observation for each factor.

Table 5.5: Frequency Table of Sustainability Factors Based on Responses Received in Survey1

Sustainability Factors													
Code	**Scale**										**Total**		**Mode**
	1		**2**		**3**		**4**		**5**				
	f	**%**	**f**	**%**	**f**	**%**	**f**	**%**	**f**	**%**	**NO.**	**%**	
F1	1	.7	10	7.4	32	23.5	57	41.9	36	26.5	136	100	4
F2	1	.7	14	10.3	41	30.1	51	37.5	29	21.3	136	100	4
F3	4	2.9	12	8.8	36	26.5	50	36.8	34	25.0	136	100	4
F4	3	2.2	18	13.2	46	33.8	49	36.0	20	14.7	136	100	4
F5	0	0	34	25.0	41	30.1	29	21.3	32	23.5	136	100	3
F6	13	9.6	52	38.2	42	30.9	22	16.2	7	5.1	136	100	2
F7	3	2.2	24	17.6	51	37.5	44	32.4	14	10.3	136	100	3

Sustainability Factors contd.													
F8	5	3.7	21	15.4	64	47.1	33	24.3	13	9.6	136	100	3
F9	9	6.6	7	5.1	50	36.8	54	39.7	16	11.8	136	100	4
F10	2	1.5	15	11.0	33	24.3	57	41.9	29	21.3	136	100	4
F11	10	7.4	23	16.9	51	37.5	35	25.7	17	12.5	136	100	3
F12	6	4.4	15	11.0	66	48.5	36	26.5	13	9.6	136	100	3
F13	17	12.5	51	37.5	48	35.3	19	14.0	1	.7	136	100	2
F14	0	0	0	0	16	11.8	40	29.4	80	58.8	136	100	5

5.2.2.2 Determining the Sustainability Factors:

Table 5.6 shows the analysed set of sustainability factors based on responses received in survey 1 using a consensus based methodology discussed under section 4.8.1.From the Table, all the factors satisfied the three conditions above with the exception of **F6** and **F13** for the following reasons:

***F6 requiring the supply side to demonstrate capability of delivering sustainability requirements*:**This factor had a mean score of 2.69 which is less than 3 required under condition one. Also a cumulative percent ranking it above the scale of 2 (3 or higher) is 52 which fall short of the 75 required under condition 2. It is therefore rejected as a relevant factor.

***F13-Allowing sufficient time in program to address and assess sustainability issues*:**

With a mean of 2.53 and a cumulative percent of 50 ranking it above 2, this factor is rejected on the same ground as F6 i.e., failing to meet conditions 1 and 2

Ultimately a total of 12 sustainability factors were identified through the questionnaire survey and subsequently subjected to verification as discussed under section 5.4.2

Table 5.6: Analysed set of sustainability factors based on responses received in survey 1

Col. 1	**Column 2**	**Column 3**		**Col. 4**	**Col. 5**	**Met Conditions**		
Code	**Sustainability Factors**	**Cumm. %**		**Mean**	**Std. Dev.**			
		1-2	**3-5**			**1**	**2**	**3**
F1	Ensure that contractors have skilled and experienced personnel and resources to implement sustainable projects	8.1	91.9	3.86	.920	✓	✓	✓
F2	Highlighting sustainability in the project brief as a primary aim	11.0	89	3.68	.948	✓	✓	✓
F3	Integrating sustainability requirements into contract specifications and conditions	11.8	88.2	3.72	1.031	✓	✓	✓
F4	Emphasizing the importance of sustainability in tender evaluation and selection procedures	15.4	84.6	3.48	.973	✓	✓	✓

F5	Incentive for the contractor/supply side to demonstrate commitment to sustainable development through policy and implementation	25.0	75	3.43	1.107	✓	✓	✓
Table 5.6 contd.								
F6	Requiring the supply side to demonstrate capability of delivering sustainability requirements	47.8	52.2	2.69	1.022	×	×	✓
F7	Contractors should provide Sustainability achievement records and examples of successfully completed sustainable projects.	19.9	80.1	3.31	.955	✓	✓	✓
F8	Encouraging tenderers to suggest innovative solutions and approaches that support the overall sustainability objectives	19.1	80.9	3.21	.944	✓	✓	✓
F9	Ensuring that payment mechanisms take account of whether sustainability requirements are delivered	11.8	88.2	3.45	.995	✓	✓	✓
F10	Ensuring that sustainability requirements can be clearly assessed and measured	12.5	87.5	3.71	.975	✓	✓	✓
F11	Promoting cultural change towards sustainability throughout the industry	24.3	75.7	3.19	1.092	✓	✓	✓

F12	Undertaking of Sustainability impact assessment on construction project	15.4	84.6	3.26	.935	✓	✓	✓
F13	Allowing sufficient time in program to address and assess sustainability issue	50.0	50	2.53	.910	×	×	✓
F14	Provision of a distinct sustainability act for the building sector	0	100	4.47	.699	✓	✓	✓

5.2.3 Section C: Identifying Sustainability Assessment Criteria

This section discusses and presents findings of the survey in relation to defining criteria for assessing sustainable construction at the various stages of the procurement process (objective 2 of the research). The analysis of the results led ultimately to the development of agreed set of sustainability assessment criteria presented under section 5.2.3.2. The process of validating these criteria is also presented under section 5.4.3

5.2.3.1 The process of identifying the assessment criteria

This section of the questionnaire is designed to solicit respondents‘ opinion on a set of assessment criteria gleaned from various sustainable constructionliteratures. These criteria are grouped under the three dimensions of sustainability:

- Social assessment criteria
- Economic assessment criteria and
- Environmental assessment criteria

Table 5.7 shows data obtained in this exercise. The first column under the table, labelled code, represents the unique codes generated for each assessment criteria as it appears in the questionnaire (A, B, and C for Social, Economic and Environmental Assessment

criteria respectively. See appendix A). These codes are maintained throughout the literature for references only. The second column shows the five point scale used in the exercise and under each scale the frequency **(f)** and the corresponding percentages **(%)** obtained for each factor. The last column, labelled mode, shows the scale value with the highest observation for each factor.

Table 5.7: Frequency Table on Assessment Criteria (Source: Survey data)

CODE.	SCALE										TOTAL		MODE
	1		2		3		4		5				
	f	%	f	%	f	%	f	%	f	%	NO.	%	
A. SOCIAL CRITERIA													
A1	4	2.9	14	10.3	30	22.1	**48**	35.3	40	29.4	136	100	4
A2	0	0	10	7.4	46	33.8	**47**	34.6	33	24.3	136	100	4
A3	4	2.9	14	10.3	**48**	35.3	43	31.6	27	19.9	136	100	3
A4	0	0	9	6.6	18	13.2	37	27.2	**72**	52.9	136	100	5
A5	0	0	7	5.1	21	15.4	**63**	46.3	45	33.1	136	100	4
A6	0	0	19	14.0	**54**	39.7	37	27.2	26	19.1	136	100	3
A7	5	3.7	21	15.4	**52**	38.2	38	27.9	20	14.7	136	100	3

A8	4	2.9	**41**	30.1	**41**	30.1	38	27.9	12	8.8	136	100	2,3
A9	0	0	0	0	40	29.4	42	30.9	**54**	39.7	136	100	5
A10	3	2.2	16	11.8	46	33.8	**50**	36.8	21	15.4	136	100	4
A11	9	6.6	34	25.0	**37**	27.2	33	24.3	23	16.9	136	100	3
A12	8	5.9	31	22.8	**39**	28.7	36	26.5	22	16.2	136	100	3
A13	9	6.6	19	14.0	37	27.2	**38**	27.9	33	24.3	136	100	4

SOCIAL ASSESSMENT CRITERIA CONTD.													
A14	20	14.7	33	24.3	**40**	29.4	28	20.6	15	11.0	136	100	3
B. ECONOMIC CRITERIA													
B1	0		0		31	22.8	59	43.4	46	33.8	136	100	4
B2	0		0		30	22.1	47	34.6	59	43.4	136	100	5
B3	0		11	8.1	36	26.5	51	37.5	38	27.9	136	100	4
B4	0		0		41	30.1	36	26.5	59	43.4	136	100	5
B5	0		0		42	30.9	51	37.5	43	31.6	136	100	4
B6	0		14	10.3	44	32.4	46	33.8	32	23.5	136	100	4
B7	15	11.0	24	17.6	49	36.0	33	24.3	15	11.0	136	100	3
B8	21	15.4	30	22.1	46	33.8	23	16.9	16	11.8	136	100	3

B9	0		7	5.1	40	29.4	56	41.2	33	24.3	136	100	4
C. ENVIRONMENTAL CRITERIA													
C1	0	0	0	0	33	24.3	58	42.6	45	33.1	136	100	4
C2	0	0	8	5.9	60	44.1	38	27.9	30	22.1	136	100	3
C3	0	0	7	5.1	44	32.4	49	36.0	36	26.5	136	100	4
C4	6	4.4	26	19.1	50	36.8	34	25.0	20	14.7	136	100	3
C5	0	0	0	0	26	19.1	54	39.7	56	41.2	136	100	5
ECONOMIC ASSESSMENT CRITERIA CONTD.													
C6	0	0	0	0	33	24.3	48	35.3	55	40.4	136	100	5
C7	0	0	2	1.5	35	25.7	59	43.4	40	29.4	136	100	4
C8	0	0	13	9.6	59	43.4	32	23.5	32	23.5	136	100	3
C9	9	6.6	24	17.6	52	38.2	35	25.7	16	11.8	136	100	3
C10	0	0	9	6.6	40	29.4	47	34.6	40	29.4	136	100	4
C11	17	12.5	40	29.4	42	30.9	24	17.6	13	9.6	136	100	3

5.2.3.2 Determining the assessment criteria:

Once again a consensus based methodology described under section 4.8.1 was employed to determine the relevant assessment criteria under the three sustainability dimensions. Table 5.8 shows the analysed set of responses obtained in this exercise.

Table 5.8: Analysed set of Assessment Criteria based on Survey Result

Col. 1	Column 2	Column 3		Col. 4	Col. 5	Condition Met		
Code	Assessment Criteria	Cumm. %		Men	Std. Dev.			
		1- 2	3- 5			1	2	3
A. Social Assessment Criteria								
A1	Improving health and safety performance	6.2	93.8	3.78	1.073	✓	✓	✓
A2	Participation of stakeholders (including community involvement)	5.8	94.2	3.76	.907	✓	✓	✓
A3	Social inclusion (including tackling poverty and social exclusion	14.6	85.4	3.55	1.017	✓	✓	✓
A4	Seeking intergenerational equity by considering cost for future generation	6.6	93.4	4.26	.929	✓	✓	✓

A5	Creating employment opportunities	5.4	94.6	4.07	.831	✓	✓	✓
A6	Training and development of the workforce	14.8	85.2	3.51	.958	✓	✓	✓
A7	Improving working environment and conditions	19.5	80.5	3.35	1.028	✓	✓	✓
A8	Equality and diversity in the Workplace	33.1	66.9	3.10	1.025	✓	×	✓
A9	Consideration of user needs and satisfaction (such as accessibility)	0	100	4.10	.828	✓	✓	✓

Social Assessment Criteria contd.								
A10	Creating a positive impact on the local environment (e. g. local community, business, infrastructure)	14.4	85.6	3.51	.966	✓	✓	✓
A11	Preservation of culture and heritage	31.1	68.9	3.20	1.185	✓	×	✓
A12	Minimising the disruptive impacts of construction (e. g. noise)	28.7	71.3	3.24	1.151	✓	×	✓
A13	Promoting equitable distribution of costs and benefits (at local, regional and international levels)	20.4	79.6	3.49	1.193	✓	✓	✓
A14	Building and maintaining social capital	37.4	62.6	2.89	1.215	×	×	×
B. Economic Assessment Criteria								

B1	Clear establishment of need and evaluation of alternative options	0	100	4.11	.747	✓	✓	✓
B2	Consideration of whole life costing and value for money	0	100	4.21	.783	✓	✓	✓
B3	Supporting the regional / local economy (including stimulating demand for local labour, businesses, materials and services)	8.1	91.9	3.85	.923	✓	✓	✓
B4	Financial affordability for intended beneficiaries	0	100	4.13	.850	✓	✓	✓
B5	Competitiveness	0	100	4.01	.793	✓	✓	✓
Economic Assessment Criteria contd.								
B6	Waste reduction and management	10.3	89.0	3.71	.944	✓	✓	✓
B7	Consideration of effective logistics strategies	28.7	71.3	3.07	1.143	✓	×	✓
B8	Improving the efficiency of the supply side	37.5	62.5	2.88	1.214	×	×	×
B9	Fitness for purpose (e.g. consideration of long term flexibility)	5.1	94.9	3.85	.851	✓	✓	✓
C. Environmental Assessment Criteria								
C1	Selection and use of materials (including specifying low environmental impact materials, re-use and recycling)	0	100	4.09	.755	✓	✓	✓

C2	Reducing water and energy consumption	5.9	94.1	3.66	.888	✓	✓	✓
C3	Sustainable land use and re-use (including giving priority to re-using previously-developed land and reducing consumption of undeveloped land)	5.1	94.9	3.84	.880	✓	✓	✓
C4	Reusing existing built asset	23.5	76.5	3.26	1.070	✓	✓	✓
C5	Considering the use of renewable resources (e.g. renewable energy) and reducing the use of non-renewable resource	0	100	4.22	.747	✓	✓	✓
C6	Minimising water, land and air pollution (including noise)	0	100	4.16	.791	✓	✓	✓
C7	Preserving and enhancing biodiversity	1.5	98.5	4.01	.784	✓	✓	✓
Environmental Assessment Criteria contd.								
C8	Waste minimisation and management	9.6	90.4	3.61	.952	✓	✓	✓
C9	Protecting and enhancing sensitive landscapes (e.g. valuable scenic and cultural areas)	24.3	75.7	3.18	1.069	✓	✓	✓
C10	Creating a healthy, non-toxic internal environment through appropriate specifications and installation (e.g. High indoor air quality	6.6	93.4	3.87	.917	✓	✓	✓
C11	Minimising - negative visual impact	41.9	58.1	2.82	1.154	×	×	✓

A. Social Assessment Criteria: Four criteria under this assessment category did not satisfy all the three conditions above and therefore disregarded

- Criterion A8 -*Equality and diversity in the Workplace*, A11- *Preservation of culture and heritage* and A12- *Minimising the disruptive impacts of construction (e. g. noise),*each achieved a cumulative percentage of 66.9, 68.9 and 71.3 of respondents scaling above 2 (slightly important) respectively. These figures, however, fall short of the required 75 percent as under condition 2. Conditions 1 and 3 were, however met.
- The assessment criterion, A14- *Building and maintaining social capital,*did not satisfy any of the three conditions required.

B. Economic Assessment Criteria: two criteria did not satisfy all the three conditions required.

- B7- *Consideration of effective logistics strategies.* With 28.7 percent of respondent scaling this criterion below 3 (important) it is disregarded.
- B8- *Improving the efficiency of the supply side,* did not satisfy any of the conditions

C. Environmental Assessment Criteria: The entire criteria under this assessment category met the three conditions with the exception of C11- *Minimising negative visual impact.* With a mean value of 2.82 and a cumulative percent of 58.1 ranking it above the scale of 2 (3 or higher) this criterion failed to satisfy conditions 1 and 2. It is therefore rejected.

5.3 Survey Questionnaire Part Two

Content: Questionnaire for the second part of the survey was designed to canvas opinions from procurement practitioners and experts who are actively involved or responsible for construction procurement in their establishment/organization on the role of procuring entity (client) in achieving sustainable construction. The questionnaires were sent

together with substantive information about the research, the aim and concise definition of major keywords to enable respondents to appreciate and answer the questions righty. Respondents were also given the opportunity to comment and make recommendations on the items presented in the questionnaire. The questionnaire also sought background information about the respondents to ensure that the target group was reached. Finally, respondents were assured of their anonymity and that information provided was to be used for the research project only.

Responses

A total of 172 questionnaires were distributed to professionals who are actively associated with procurement activities and possessing sufficient experience in their respective fields and organizations. A total of 122 questionnaires was completed and returned, representing a response rate of 71 percent. Some of the returned questionnaires were rejected on grounds of ambiguity and inconsistency. A total of 114 was therefore found eligible for analysis. In order to gain further qualitative insight into perceptions and opinions within the industry, the respondents were encouraged to make further open comments at the end of the questionnaire.

5.3.1 Section A-Respondent's Background

As with the first survey this section of the questionnaire was to capture relevant background information about the respondents' for the same reason as with the first survey. In all, 114 responses were analysed with no missing data in any of the categories.

5.3.1.1 Educational background of respondents

The number and percentage of respondents belonging to each category are shown in Table 5.9. From the result obtained, It could be observed that 58 percent of the respondents are degree holders (first degree or higher) and 20 percent being undergraduate (diploma and

certificate holders including those pursuing college degrees). Together, these categories of respondents represent 78 percent.

Table 5.9: Respondents' education background from survey 2

Qualification	Undergraduate	Graduate	Postgraduate	Other	Total
Frequency	23	46	18	25	114
Percentage	20	42	16	22	100

5.3.1.2 Nature of Establishment Respondent Works Under

The result from Table 5.10 shows a fair representation across the different establishment. Diversification and differences in opinion could therefore be expected.

Table 5.10 Respondents' establishment category from survey 2

Category	Local Authority (MMDAs, MDAs, etc.)	Education	Health	Business/ Finance	Other establishments	Total
Frequency	31	22	18	27	16	114
Percentage	27	19	16	24	14	100

5.3.1.3 Respondents years of experience

About 62 percent of the respondents have over ten years of working experience (see Table 5.11). This figure is very significant given the central role experience plays in the acquisition of knowledge. These categories of respondents are deemed well informed to give valuable opinion on the subject matter.

Table 5.11 Respondents' years of experience from survey 2

Category	Up to 5 yrs.	6 – 10 yrs.	11 – 20 yrs.	21- 30 yrs.	Over 30 yrs.	Total
Frequency	16	27	39	21	11	114
Percentage	14	24	34	18	10	100

5.3.2 Section B: Role of Procuring Entities in Achieving Sustainable Construction This section presents the outcome in relation to Part two of the survey for the accomplishment of objective 3-*To find the role of procurement entities in achieving sustainable construction*. The analysis of the results, as presented under Section 5.3.2.1, led ultimately to the development set of generic roles procuring entities could play in the quest to achieving sustainable construction.

5.3.2.1 The process of Identifying the Role of Procuring Entities in achieving sustainable construction

The survey questionnaire was prepared to determine the extent of agreement (consensus) among respondents on sets of data gleaned from related studies that outline *the role of procuring entities*in achieving sustainable construction along the procurement route in the Ghanaian construction sector. Table 5.12 shows the analysed set of responses obtained in this exercise.

*Table5.12*The column labelled ***—scale"***shows the frequency and corresponding percentage for each scale value. The last three columns from left to right show the **mean, standard deviation** and **mode** respectively.

Table 5.12Analysed set of Factors – Role of Procuring Entities based on Survey 2

Survey Data - Role of Procuring Entities in achieving sustainable construction												
Code	**Item**	**Scale***								**Mean**	**S.D**	**Mode**
		2		**3**		**4**		**5**				
		f	**%**	**f**	**%**	**f**	**%**	**f**	**%**			
R1	Procuring entities need common understanding regarding sustainable construction	4	3.5	8	7.0	42	36.8	60	52.6	4.39	.770	5
R2	Training on sustainability issues, particularly at the level of senior procurement decision makers	2	1.8	14	12.3	35	30.7	63	55.3	4.39	.771	5
R3	Evaluating alternative procurement methods/routes in terms of their potential to deliver sustainability objectives	3	2.6	12	10.5	41	36.0	58	50.9	4.35	.776	5
R4	Ensuring the consideration of a complete range of options to meet organizations infrastructural needs (e.g. refurbishment, new build)	5	4.4	8	7.0	53	46.5	48	42.1	4.26	.776	4
R5	Incorporating sustainability issues in procurement decisionmaking	0	0	5	4.4	27	23.7	82	71.9	4.68	.556	5
R6	Promoting corporate social responsibility policy that runs parallel with sustainability	6	5.3	14	12.3	50	43.9	44	38.6	4.16	.837	4

Table 5.12 contd.

R7	Sustainability Assessment at various stages of construction procurement	3	2.6	17	14.9	54	47.4	40	35.1	4.15	.767	4
R8	Priority to re-using previously developed land and reducing consumption of undeveloped land	5	4.4	20	17.5	53	46.5	36	31.6	4.05	.818	4
R9	Requiring reviews to be conducted to monitor the delivery of sustainability requirements throughout the project life cycle	4	3.5	13	11.4	51	44.7	46	40.4	4.22	.784	4
R10	Adopting a balanced approach that ensures the explicit consideration of all sustainability dimensions	0	.0	14	12.3	29	25.4	71	62.3	4.50	.707	5
R11	Ensuring that client organisations have clear policies and guidelines regarding the application of sustainability principles in the procurement of infrastructure	0	.0	14	12.3	39	34.2	61	53.5	4.41	.702	5
R12	Improving communication and knowledge sharing within the client organisation regarding sustainability implementation and best practice	0	.0	20	17.5	29	25.4	65	57.0	4.39	.771	5

**No entry was found for scale value 1 and is therefore discarded in the table*

5.3.2.2 Determining the Important Factors:

Based on the scale values used, a factor is considered important if it satisfies conditions 1 and 3 under section 4.8.1.1

Analysis of the responses shows a strong conviction among respondents with regards to the importance of the items presented. This is evidenced in the higher mean values obtained. Furthermore, all the items fall within one standard deviation of the mean value, an indication of greater consensus. All 12 items in the questionnaire satisfied the conditions above and were subjected to validation accordingly.

5.4 Validation of Survey Results

As discussed under section 5.1, the findings resulting from the two surveys under sections 5.2 and 5.3 were validated through interviews with experts in the construction procurement. Selection of participants for the interview was based on several indicators of knowledge. (Henchion and McIntyre, 2005; Khosrow-Pour and Herman, 2001; Martino, 1983; Scholl *et al*., 2004; Shon and Swatman, 1998) Among these indicators are:

- Publications in the field
- Signs of professionals‘ eminence
- Peer judgement and recommendations
- Honours by professional societies
- Self-rating of the expertise
- Relevant years of experience.

In all a total of 11 experts were contacted for the interview out of which 9 responded to partake in the interview. Table 5.3 Provides relevant information about the interviewees.

5.4.1 Interviewees Background

All the interviewees have attained a higher level of education with a majority 8 out of the total having a post graduate degree. Their higher status of education could be attributed to the knowledge required of their profession and areas of specialization. The profession and areas of specialization of the interviewees are directly related to the topic under study, which is an added advantage for the purpose of validation. The number of years on the job which is also an indicator of experience level (knowledge acquired in the field; Kolb, 1984) ranges from 17 to 33 with an average of 23.73 also lends much credentials to the interviewees.

5.4.2 Validation of Sustainability Factors

The interviewees had the opportunity to give their impressions on the finding from the survey conducted. In order not to influence their judgment these findings were presented as raw data canvassed from literature rather than a survey. Generally, no negative comment was noted. They were then asked to rank each factor on a scale of 1denoting not important to 5- denoting extremely important. Table 5.9 presents the result of these exercises. In the analysis that followed the interview the mean value was computed (see column 4 of table 5.13) and compared with that obtained in the questionnaire survey (see column 5 of table 5.13). Given that the number is low in the interview, only the mean is used as the basis for comparison.

The result of the interview shows a stronger conviction on the sustainability factors in terms of its importance as indicative of the higher mean values observed compared to the survey result. In fact, all the factors except F14 have a higher mean value than the survey result. Hence all 12 factors are considered valid as sustainability factors. Section 5.5.1 of the chapter discusses the sustainability factors.

Table 5.13:Interviewee's Background(Source: Survey Data)

Interviewee	**Level of education**	**Profession**	**Area of specialization**	**Years on job**
A	Postgraduate	Quantity Surveyor	Construction procurement and Management	21
B	Postgraduate	Academician	Research and Academics	18
C	Postgraduate	Engineer	N/A	31
D	Graduate	Procurement Expert	Procurement, contract management	24
E	Postgraduate	Architect	Design of sustainable buildings, procurement consultancy	26
F	Graduate	Engineer	Building and road construction	19
G	Graduate	Environmentalist	Research, environmental consultancy	28
H	Postgraduate	Architect	Building designer and consultant	33

I	Postgraduate	Academician	Research and academics	22
J	Postgraduate	Engineer	Building and road construction	22
K	Post Graduate	Quantity Surveyor	Construction management	17

Table 5.14: Validation of Sustainability Factors - Survey 1

Col 1	**Column 2**	**Column 3**	**Col 4**	**Col 5**

Code	**Item**	**Interviewees**									**Mean Intv.**	**Mean Surv.**
		A	B	C	D	E	F	G	H	I		
F1	Ensure that the contractors have skilled and experienced resources to implement sustainable projects	4	5	5	5	4	3	3	4	4	4.11	3.86
F2	Highlighting sustainability in the project brief as a primary aim	5	5	4	4	5	4	5	4	4	4.44	3.68
F3	Integrating sustainability requirements into contract specifications and conditions	4	4	5	5	3	4	4	3	4	4.00	3.72
F4	Emphasising the importance of sustainability in tender evaluation and selection procedures	5	3	3	3	4	4	4	3	4	3.67	3.48

F5	Incentive for the contractor/supply side to demonstrate commitment to sustainable development through policy and implementation	3	4	4	5	5	3	4	3	3	3.78	3.43
F7	Contractors should provide Sustainability achievement records and examples of successfully completed sustainable projects.	4	4	4	5	3	4	3	4	4	3.89	3.31
F8	Encouraging tenderers to suggest innovative solutions and approaches that support the overall sustainability objectives	4	4	5	5	4	3	3	4	4	4.00	3.21

Table 5.14 contd.

F9	Ensuring that payment mechanisms take account of whether sustainability	5	5	4	5	5	3	5	3	4	4.33	3.45
	requirements are delivered											
F10	Ensuring that sustainability requirements can be clearly assessed and measured	4	4	5	5	5	4	4	3	4	4.22	3.71
F11	Promoting cultural change towards sustainability throughout the industry	5	3	4	3	4	5	4	3	4	3.89	3.19
F12	Undertaking of Sustainability impact assessment of construction project	3	4	4	5	5	5	4	5	4	4.33	3.26
F14	Provision of a distinct sustainability act for the building sector	4	4	4	5	5	4	5	4	4	4.33	4.47

5.4.3 Validation of Assessment Criteria

The procedure for validating the assessment criteria followed the one applied for the sustainability factors. The interviewees had the opportunity to give their impressions on the finding from the survey and to rank the assessment criteria under social, economic and environmental sustainability on a scale of 1-denoting not important to 5- denoting extremely important. Table 5.15 presents the result. The mean values from the validation exercise and that from the survey analysis is shown under columns 4 and 5 of table 5.14 respectively.

Table 5.15: Validation of Assessment Criteria - Survey 1

Col 1	Column 2	Column 3	Col 4	Col 5
A Social ssessment Criteria				

Code	**Item**	**Interviewees**									Mean Intv.	Mean Surv.
		A	**B**	**C**	**D**	**E**	**F**	**G**	**H**	**I**		
A1	Improving health and safety performance	4	5	3	5	4	3	3	4	4	3.89	3.78
A2	Participation of stakeholders (including community involvement)	3	5	4	4	5	4	4	4	4	4.11	3.76
A3	Social inclusion (including tackling poverty and social exclusion	4	4	3	5	3	4	4	3	4	3.78	3.55

A4	Seeking intergenerational equity by considering cost for future generation	5	3	5	3	4	5	4	3	4	4.00	4.26
A5	Creating employment opportunities	3	4	4	5	5	3	4	3	3	3.78	4.07
A6	Training and development of the workforce	3	4	4	5	5	4	3	4	4	4.00	3.51
A7	Improving working environment and conditions	4	4	5	5	4	4	4	4	4	4.22	3.35
A9	Consideration of user needs and satisfaction (such as accessibility)	4	4	5	5	5	3	4	3	4	4.11	4.10
A10	Creating a positive impact on the local environment (e. g. local community, business, infrastructure)	5	3	5	3	4	5	3	3	4	3.89	3.51

Table 5.15 contd.

A13	Promoting equitable distribution of costs and benefits (at local, regional and international levels)	5	5	4	5	5	3	5	4	4	4.44	3.49

B. Economic Assessment Criteria

Code	Item	Interviewees									Mean Intv.	Mean Surv.

B1	Clear establishment of need and evaluation of alternative options	3	4	3	4	5	5	4	5	5	4.22	4.11
B2	Consideration of whole life costing and value for money	4	5	4	5	5	3	5	4	3	4.22	4.21
B3	Supporting the regional / local economy (including stimulating demand for local labour, businesses, materials and services)	5	4	4	4	3	3	5	3	4	3.89	3.85
B4	Financial affordability for intended beneficiaries	4	5	4	3	5	5	4	4	4	4.22	4.13
B5	Competitiveness	4	4	5	4	5	3	4	5	5	4.33	4.01
B6	Waste reduction and management	5	4	5	5	4	4	5	5	4	4.56	3.71
B9	Fitness for purpose (e.g. consideration of long term flexibility	4	3	4	3	4	4	3	4	3	3.56	3.85
C. Environmental Assessment Criteria												
Code	Item	Interviewees									Mean Intv.	Mean Surv.
C1	Selection and use of materials (including specifying low environmental impact materials, re-use and recycling)	4	5	3	5	5	4	3	5	5	4.33	4.09

C2	Reducing water and energy consumption	3	5	4	5	5	4	4	4	4	4.22	3.66
C3	Sustainable land use and re-use (including giving priority to reusing previously- developed land and reducing consumption of undeveloped land)	5	4	3	4	3	4	4	4	4	3.89	3.84
C4	Reusing existing built asset	4	4	4	3	4	5	4	4	4	4.00	3.26
C5	Considering the use of renewable resources (e.g. renewable energy) and reducing the use of nonrenewable resource	4	4	5	4	5	4	4	5	5	4.44	4.22
C6	Minimising water, land and air pollution (including noise	5	4	4	5	5	4	5	4	4	4.44	4.16
C7	Preserving and enhancing biodiversity	4	4	4	5	4	4	4	4	5	4.22	4.01
C8	waste minimisation and management	4	4	5	5	5	5	4	5	4	4.56	3.61
C9	Protecting and enhancing sensitive landscapes (valuable scenic and cultural areas)	3	3	5	3	4	5	3	3	4	3.67	3.18

Table 5.15 contd.

C10	Creating a healthy, non-toxic internal environment through appropriate specifications and	3	4	4	4	3	4	3	4	4	3.67	3.87
	installation (e.g. high indoor air quality											

As was in the case for the sustainability factors, the result of the interview shows the result obtained from the survey are valid as indicative of the higher mean values observed in the interview.

5.4.4 Validation of Factors-Role of Procuring Entities in achieving SC

Using the procedure adopted under section 5.4.1, the survey result of factors outlining the role of procuring entities in achieving sustainable construction is verified. Table 5.15 presents the result of these exercises. The interview result validates all the items, with the exception of *R8-Priority to re-using previously developed land and reducing consumption of undeveloped land*. With a mean value of 2.89 this factor failed the validation test and is therefore rejected. The remaining eleven factors which represent the role of procuring entities in achieving sustainable construction are discussed under section 5.5.3

Table 5.16: Validation of Factors-Role of Procuring Entities

Col .1	Column 2	Column 3	Col. 4	Col. 5
Code	Role of Procuring Entity.	Interviewees	Mean	Mean

	Data From Survey 2	A	B	C	D	E	F	G	H	I	Intv.	Surv
R1	Procuring entity need a common understanding regarding sustainable construction	5	4	5	4	4	3	4	5	4	4.22	3.86
R2	training on sustainability issues, particularly at the level of senior procurement decision makers	4	4	4	5	4	4	5	5	5	4.44	3.68
R3	Evaluating alternative procurement methods/routes in terms of their potential to deliver sustainability objectives	5	5	4	4	3	3	4	3	5	4.00	3.72
R4	Ensuring the consideration of a complete range of options to meet organizations infrastructural needs (e.g. refurbishment, new build)	4	3	4	5	2	4	3	5	4	3.78	3.48
R5	incorporating sustainability issues in procurement decision making	5	5	5	5	5	5	5	5	5	5.00	3.43
R6	Promoting corporate social responsibility policy that runs parallel with sustainability	4	4	4	4	4	4	5	4	4	4.11	3.31
R7	Sustainability Assessment at various stages of construction procurement	3	3	4	4	4	5	5	4	4	4.00	3.21
Table 5.16 contd.												
R8	priority to re-using previously developed land and reducing consumption of undeveloped land	4	2	2	3	4	3	2	2	4	2.89	3.45

R9	Requiring reviews to be conducted to monitor the delivery of sustainability requirements throughout the project life cycle	4	5	4	5	3	4	4	5	4	4.22	3.71
R10	Adopting a balanced approach that ensures the explicit consideration of all sustainability dimensions	5	4	4	3	4	5	4	4	4	4.11	3.19
R11	Ensuring that client organisations have clear policies and guidelines regarding the application of sustainability principles in the procurement of infrastructure	5	5	4	5	5	4	5	5	5	4.78	3.26
R12	Improving communication and knowledge sharing within the client organisation regarding sustainability implementation and best practice	4	4	4	3	5	4	3	5	4	4.00	4.47

5.5 Discussion of results.

This section presentsa discussion of the results obtained in the research with corroborative data from related studies in order to illuminate the underlying issues.

5.5.1 Sustainability factors.

In all, 12 sustainability factors ensued from the research as follows:

- ***F1-Ensure that contractors have skilled and experienced personnel and resources to implement sustainable projects:***

It is important for the contractor/supply team to envision sustainability as an essential aspect of the project process and to ensure that the team includes appropriately skilled and experienced personnel and expert, with the appropriate backup and technical knowhow to deliver the project (OGC, 2007).

- ***F2-Highlighting sustainability in the project brief as a primary aim:***

The project brief, according to Sourani and Sohail, (2005) delineates the completed project, the expected outcome and highlight the role of the contractor together with expected constraints and difficulties. It, therefore, ―serves as information carrier during the design and production phases in construction‖ (Ryd, 2004). Hence, the formulation of the design brief to include sustainability issues guarantees that the client's needs on sustainability is intentionally conceived by all parties and enables the presentation of same in a way that cannot be ignored at any of the project-delivery stages (OGC, 2005; Sourani and Sohail, 2005).

- ***F3-Integrating sustainability requirements into contract specifications and conditions:***

The formulation of contract specifications that integrates sustainability as a means to realizing SC objectives is much acknowledged in several publications (*c.f* OGC, 2005a; Addis and Talbot, 2001; NHS Estates, 2001; Environmental Audit Committee, 2005b). This, as observed by Sourani (2013), separates the initial capital cost of the project from other life-cycle cost,thusnourishing the attainment of sustainability objectives.

- ***F4-Emphasizing the importance of sustainability in tender evaluation and selection procedures:***

The OGC (2007) sustainability guide, *Achieving Excellence in Construction*

Procurement outlined the importance of making sustainability an integral aspect of the pre-qualification and tender assessment process as it inspires explicit consideration of sustainability requirements of the contractor and supports innovation in their responses. The contract brief should therefore, outline clearly the sustainability assessment criteria those tendering will be measured against.

- ***F5-Incentives for the contractor/supply side to demonstrate commitment to sustainable development through policy and implementation***

It is helpful to ask contractors and suppliers to set out in a separate section of their tender how they meet (or exceed) the specified sustainability criteria.

- ***F7-Contractors should provide Sustainability achievement records and examples of successfully completed sustainable project***

It is important for entities to demand for evidence and achievement records on successfully completed sustainable project and where possible to arrange for a site visitation for examinations to be conducted. It may also be helpful to solicitinformation regarding the delivery process and the current operation of the facility with respect to the sustainability requirement from owners and occupants during the visit (OGC, 2007).

- ***F8-Encouraging tenderers to suggest innovative solutions and approaches that support the overall sustainability objectives***

The importance of attaining innovative solutions and approaches from tenderers was mentioned on several occasions in the literature. OGC (2005) shows that tender documentation can encourage suppliers to provide innovative sustainable solutions. If clients specify their sustainability objectives without prescribing how these objectives can be achieved by the tenderers, they would be encouraged to provide innovative

solutions in their responses (OGC, 2005a; Business Vantage, 2005). Tenderers may be asked to show in a separate section of the tender how they will meet or exceed the specified sustainability objectives (OGC, 2005a).

- ***F9-Ensuring that payment mechanisms take account of whether sustainability requirements are delivered***

One way of ensuring the delivery of sustainability requirement is by linking it to payment mechanisms as it serves as an incentive for the contractor to deliver these requirements (sourani 2008). This link can be established through contract specifications and conditions. This criterion also runs parallel with the demand by OGC for public clients to introduce sustainability KPIs into payment mechanisms during the contract preparation process (OGC, 2005a).

- ***F10-Ensuring that sustainability requirements can be clearly assessed and measured***

Without the ability to clearly assess and measure progress towards a sustainable construction industry, efforts toward realizing sustainable goals are likely to be futile. It is therefore of utmost important to device an assessment criteria together with measurement methodology along economic, social and environmental dimension in line with the principle of triple bottom line. This will facilitate monitored, recording and reporting on-site performance and sending feedback to the client and other parties (OGC, 2007).

- ***F11-Promoting cultural change towards sustainability throughout the industry***

The construction industry has been tagged as "inherently defensive" for change (CIB, 1999) this phenomena coupled with the industry's fragmented nature and lack of long term perspective have all been factors hindering the advancement in the direction of more

sustainable construction (CRISP Sustainable Construction Theme Group, 1999; DETR, 2000). Culture change across the industry is therefore required in order to share the same overall sustainability goals and find means of working that allow the expertise of all stakeholders to be brought together at a stage in the project where an actual difference can be achieved. Changes will be required from all parties, including clients, consultants, contractors and their supply chains (Berry and McCarthy 2011).

Awareness raising and education of the different parties, producing best practice guidance, recognising the business case for better social and environmental performance, and competitive pressure has been recommended to address the need for cultural change towards sustainability industry (DETR, 2000).

- ***F12-The undertaking of Sustainability risk/impact assessment of construction project.***

It is important to assess possible sustainability risk or impact of a proposed scheme on the environment, the local economy, the community and on issues such as equalities, to make a list thereof, prioritise and to determine actions accordingly to curb or minimise

A Toolkit developed by the London Borough of Camden as part of the London Centre of Excellence Sustainable Procurement Project was aimed at providing guidance for including sustainability in tendering procedures. Included In the toolkit is a model that was to be used to undertake sustainability risk/impact assessment. Possible sustainability risk ass suggested in the toolkit includes:

- The risk of causing harm to the environment, through execution of the contract, e.g. utilising a service or using an item of equipment.

- Risk of damaging the organisation‘s reputation, through execution of the contract. This could be attributable to any environmental damage caused or

  likely to be caused through contract execution throughout the supply-chain, or to the reputation of the supplier delivering the contract.
- Risk of missing opportunities to aggregate benefits across service delivery areas.
- Risk of delivering poor value for money resulting in remedial costs and greater maintenance requirements.

Undoubtedly, undertaking the risk assessment is one of the fundamental requirements for implementing sustainability within your contract.

- ***F14-Provision of a distinct sustainability act for the building sector***

There are on-going debates as to whether sustainability principles, such as seeking fair and just society, working within environmental limit, etc., should be spelt out in statute or receive other statutory protection. It‘s been argued that such provisions could set out certain objectives or Sustainability guidelines that must be considered and thus explicitly incorporate certain established values into procurement decision-making processes. Countries such as Quebec and Manitoba have adopted such an arrangement (Sustainable Development Act, 2006). The Manitoba statute, for example contains both substantive guiding principles for sustainable development so that it actually becomes the main organising principle of government (Sustainable Development Act, 1997). Thus a distinct act for sustainability in the context of a sustainable construction industry is not out of place.

5.5.3 Social Assessment Criteria

The criteria for assessing the social dimension of SC that emerged from the research are:

- ***A1-Improving health and safety performance***

The ability to judge whether health and safety concerns are adequately taken care of is vital to the realization of the social sustainability objective. This can be achieved by Ensuring that right from the initiation of the project, appropriate resources have been allocated to facilitate compliance with Health and Safety regulations. Besides the safety and well-being of occupants in and around a facility, Health and Safety should also be directed towards the well-being of construction employees (OGC, 2007; Sourani and Sohail, 2011).

In the case of London Borough of Camden, standard pre-qualification questionnaire were formulated to solicit information from tenderers on how health and safety are managed in their respective organizations and on construction sites. Evidence of adherence to appropriate health and safety legislation were also required all of which were incorporated into the tender evaluation process. In addition, the contract strategy highlights the importance of identifying any significant health and safety implications with the contract and ensuring that attention is paid to safest solutions in specifying goods and service (Sourani, 2008).

Assessing the possible impact on the health or safety of the facility's occupants or indeed those involved in the construction process with regards to installed equipment and materials provides another means of improving health and safety (OGC 2007).

- ***A2-Participation of stakeholders (including community involvement)***

This assessment criterion runs parallel with one of the key principles in the OGC (2007) procurement guide and provides an excellent means of realizing the social objective of sustainable construction. Stakeholders need to be identified, prioritised and engaged

.Participation of stakeholders means identifying, prioritising and consulting the General public, local community, End users, local and national government, Client, Contractors, project team, Facility managers, Investors, etc., during the decision-making process in order to identify their needs and to respond accordingly in a continuous dialogue (CIRIA, 2006; OGC, 2007). This can furnish solutions to potential problems while mitigating unnecessary disputes or delays. During the manufacturing of the Syrian cement plant, the Syrian cement company(SCC) A public consultation process was undertaken in accordance with Syrian EIA Act, Annex 4 for ―Public Participation – Mechanisms and Procedures‖, which called for a Public Hearing during the scoping phase of the project so as to introduce relevant stakeholders to the proposed project, its scope of work and inform the public about the anticipated impacts and the planned mitigation measures to be adopted for each impact.

- ***A3-Social inclusion (including tackling poverty and social exclusion***

This assessment criterion will ensure the development, planning and the making of provision for social self-determination and cultural diversity (Gardner, 1989).

- ***A4-Seeking intergenerational equity by considering cost for future generation***

  At the core of the sustainability goal is to ensure that future generations do not pay the price for current development models. This makes the above criterion one of the most important assessment modules as it focuses on the impact of current development patterns and its effect on future generations. A number of publications emphasised such a criterion as a key sustainability area. Examples of these include Hill and Bowen (1997) and Langford *et al.* (1999). Seeking intergenerational equity demonstrates the linkages between the different dimensions of sustainability and implies that significant social, environmental and

financial costs of current construction do not pass on to future generations (Hill and Bowen, 1997). A whole life costing approach is useful to ensure that future costs are considered. The procedures of such an approach do not only take into account the facility's initial cost but also its future costs. This has to take into account operational costs, maintenance costs and replacement/disposal costs (TCPA and WWF, 2003).

- ***A5-Creating employment opportunities.***

Employment creation is addressed through promoting local employment and increasing the number of local people whose services are engaged during the construction process (Sourani 2008). This can be achieved through a cooperate policy that promotes the use of local labour and business in construction activities as is in the case of London Borough of Camden, (2004) The creation of employment opportunities also helps to ensure that the social benefits of construction are equitably distributed, where this cannot be achieved in the intended use of the product or output of construction (OGC, 2007).

- ***A6-Training and development of workforce***

The criterion considers ways in which construction can provide training and skills enhancement, thereby creating a diverse business base and workforce.

- ***A7-Improving working environment and conditions***

This criterion considers the role design and buildings play in ensuring a healthy environment and lifestyle for would be occupants and operators as well as that of all site workers. This means identifying and implementing ways to promote healthy lifestyles such as doing away with hazardous materials, providing healthy food on site, health screening and education programmes (Berry and McCarthy, 2011).

- ***A9-Consideration of user needs and satisfaction (such as accessibility)***

A sustainable building is one that provides all users with appropriate mobility and comfort throughout. Assessment of this nature will ensure that the operation of the development (after the construction process is complete) is compatible with local human systems and technology (Yap, 1989). Consideration should be given to a design that provides for a healthy and comfortable environment as well as accessible to all – the very young, elderly or disabled (OGC 2007).

- ***A10-Creating a positive impact on the local environment (e. g. Local community, business, infrastructure)***

This criterion seeks to ensure that a proposed development scheme establishes a positive effect on the local community, provide benefits and improve the area (Berry and McCarthy 2011).

- ***A13-Promoting equitable distribution of costs and benefits (at local, regional and international levels)***

It is important to ensure that the social costs of construction are fairly or equitably distributed. In the event that this cannot be accomplished, adequate compensation must be provided to individuals or communities who have been affected by such construction undertakings.

5.5.4 Economic Assessment Criteria

The criteria for assessing the economic dimension of SC that emerged from the research are:

- ***B1-Clear establishment of need and evaluation of alternative options***

The initiation of new developments comes at a huge investment cost. It is therefore necessary and much beneficial to weigh and evaluate alternative options before deciding

on a new development. This will provide the most cost effective way of meeting organizational infrastructural needs.

- ***B2-Consideration of whole life costing and value for money***

It is important to stress the significance of life-cycle costs in delivering value for money inasmuch as sustainable projects are concerned. A life-cycle cost assessment should be used to appraise all procurement decisions. This is achieved by considering the initial costs vis-à-vis operational costs. Benefits to be accrued in this regard includes cost savings (such as lower energy consumption) waste reduction and greater productivity

- ***B3-Supporting the regional/local economy (including stimulating demand for local labour, businesses, materials and services)***

An assessment criterion that seeks to interrogate the extent to which a proposed development scheme supports local and regional economy is essential. A well planned infrastructure project rejuvenates local and regional economies through improved access to services, encouraging new businesses and providing new jobs. (OGC, 2007) The economic impact on the local community can be significantly improved when initiatives are taken to ensure that spending stays within the local economy, thereby making optimal use of its capital cost (LCPE, N/D).

- ***B4-Financial affordability for intended beneficiaries***

The above criterion presents another key assessment tool towards achieving sustainability in the procurement of an asset. According to Sourani (2008) the above criterion is related to the ability of future generations to pay for the use, operation and maintenance of the constructed facilities. This supports the views espoused by

McIntosh and Fourier (2000) who argue that sustainability is critically linked to affordability not only in terms of capital cost, but also in terms of long maintenance and cost recovery from users. The principle of financial affordability for intended beneficiaries according to Ofori, (1998) was particularly relevant to the needs of developing countries.

- ***B5-Competitiveness***

Competitiveness relates to maintaining the element of competition and motivating the industry to become more productive, efficient and successful. In the context of construction procurement, competitive tendering has the potential to motivate firms to search for ways to reduce their production costs and become more efficient and more productive (production costs involves the efficient transformation of inputs to outputs (Winch, 2002).

They should also take into account the competitors' performance on other criteria that enhance value, such as financial soundness, technical capability and experience, quality performance, health and safety performance and environmental performance.

- ***B6-Waste reduction and management***

The huge quantities of waste generated during construction activities have long been identified as a major environmental and economic setback (Ebohon*et al.*, 2010 Sourani 2008, Plessis 2007). This makes the above criterion one of the important in achieving economic and environmental sustainability. The brief could also contain a requirement for contractors and suppliers to make provisions for a Waste Management Plan. Targets could also be set for waste reduction during construction and whiles the facility is in operation and to monitoring same.Effective waste management during the construction phase and the operation of a facility helps to generate significant savings (OGC, 2007).

- ***B9-Fitness for purpose (e.g. Consideration of long term flexibility)***

Assessment should be carried out to ascertain the flexibility and adaptability of the project to future changes. This is achieved by considering the need for current users‘ future users (OGC2, 007).

5.5.5 Environmental Assessment Criteria

The environmental assessment criteria consist of:

- ***C1-Selection and use of materials (including specifying low environmental impact materials, re-use and recycling)***

This assessment criterion runs parallel with *B6- Waste reduction and management* identified above. Given certain construction materials used are harmful to the environment regained materials and products made from recycled material are less likely to cause environmental degradation. It is also imperative that materials to be incorporated in construction project be assessed on their performance and lifecycle once they are installed.

- ***C2-Reducing water and energy consumption***

Will the facility use energy efficiently? Can the local water supply cope with additional demand from the facility? Such questions can help to avert situations where the constructional and operation phases of a scheme affect local water and energy supplies.

The above criterion is set as one of the sustainability goals to be met during the numerous construction activities in the build-up to the Brazil 2014 world cup. It was specifically called for to save energy by implementing a solar power program for public lighting and measures to be taken to reduce the Amount of tap water used. (Pinto *et al*., 2011)

It‘s obviously a step in the right direction to take a long term perspective in evaluating the extent to which a development will affect local water and energy distribution as well as the broader environment effects. Facilities that make use of large amounts of energy throughout their life cycle should be discouraged (OGC, 2007).

- ***C3-Sustainable land use and re-use (including giving priority to re-using previously- developed land and reducing consumption of undeveloped land)***

Preference must all the time be given to developing brown field sites (i.e. previously developed land and buildings). This eases pressure on arable land. English Partnerships‘ study _Towards a National Brownfield Strategy‘ (November, 2003) highlights the huge potential to recycle brown field sites for future developments.

- ***C4-Reusing existing built asset***

The above assessment criterion is one of the themes in the sustainability action plan proposed by the UK government. Under the theme all relevant projects were to use one or more of the following strategies.

- Refurbishment/Reuse of existing built assets;
- New building, but planning for future refurbishment by designing for adaptability;
- New building, but planning for deconstruction and re-use; or
- New building, but planning for an easily maintainable building or built asset

The above assessment criterion also runs parallel with **C3**.

- ***C5-considering the use of renewable resources (e.g. Renewable energy) and reducing the use of non-renewable resource***

Minerals such as sand, stone, and fossil fuels are not renewable as they cannot be replenished within a human time scale (HM Government, 2005). On the other hand, biomass, including quickly renewable resources (such as agricultural crops) and slowly

renewable resources (such as timber) are renewable within that scale. In the context of construction, the principle of using renewable resources in preference to non-renewable resources is applied to both building materials and energy (Hill and Bowen, 1998).

- ***C6-Minimising water, land and air pollution (including noise)***

Setting targets in the project brief to minimize or reduce pollution where possible is much acknowledged as key to environmental sustainability (OGC, 2005). It is important to assess the extent to which the development poses risks to water, land and air pollution and to institute avoidance measures to curb it outright or minimise it to the lowest level.

- ***C7-Preserving and enhancing biodiversity***

Preservation and enhancement of biodiversity mean the conservation of all living things in their ecosystem. This can be achieved through detailed survey and environmental impact assessment as well as the creation of opportunities to enhance green species. It is important that projects undertaken on green fields seek to retain, enhance, or create features of nature conservation whilst avoiding potential threats to Sites of Special Scientific Interest (SSSI) (OGC, 2007).

- ***C8-waste minimisation and*** **management**

This criterion shares the same goal with **B6**and shows the interconnectivity and interdependency of the economic, social and environmental themes of sustainability. Production of waste is one of the possible environmental risks that need to be considered (London Borough of Camden, 2005b). Hence waste minimisation is suggested as a means of recovering in the built environment, throughout the construction phase and across the

supply chain. Including a requirement in the contract documents that contractors reuse and recycle construction waste where possible will significantly reduce waste and its effect on the environment (Berry and McCarthy, 2011; Sourani 2008).

- ***C9-Protecting and enhancing sensitive landscapes (e.g. Valuable scenic and cultural areas)***

The above criterion seeks to promote sustainability by encouraging the protection and the enrichment of the unique landscape of a locality. Development proposals have to consider the features of the area and to inspire local distinctiveness, a sense of place and respect for the historic character of the area. Further details in relation to developments affecting archaeological sites should also be provided (Sourani, 2008).

- ***C10-Creating a healthy, non-toxic internal environment through appropriate specifications and installation (e.g. high indoor air quality).***

The Sustainable Construction Policy of the Council shows that one of its main objectives is using the most environmentally and socially responsible goods and services in consistency with good performance (London Borough of Camden, 2004).

This involves avoiding materials, where possible, with significant environmental risk during the life cycle. Examples of actions highlighted by the Council to achieve this include using low solvent paints (as this can lead to reduced volatile organic solvents and risk of smog and indoor pollution) and using linoleum in place of vinyl flooring, as this can lead to reduce toxic chemicals (London Borough of Camden, 2004). The Sustainable Construction Policy and Programme of the Council presents the disadvantages associated with using PVC. Among these are its high chlorine content and toxic additives, including lead and cadmium. The Sustainable Construction Policy and Programme of the Council highlights also the performance of alternative window frame materials, such as timber, aluminium, etc. (London Borough of Camden, 2004).

5.5.6 Role of Procuring Entities in Achieving SC

The findings of the research with regards to the role of procuring entities in achieving sustainable construction are discussed below:

- ***R1 Procuring entity need a common understanding regarding sustainable construction***

The confusion surrounding what constitutes sustainability or sustainable construction for that matter has been discussed in the literature (section 2.4.8.4). Adding to the confusion is the vagueness of sustainability definitions offered and the varied backgrounds of stakeholder in construction procurement. Many still equate sustainability to environmental issues (Adetunji *et. al*., 2003). This entire phenomenon has led to some developers adopting an _easy way out' attitude when it comes to undertaking sustainability interventions.

There is therefore the need for entities to develop a common understanding regarding what constitutes sustainable construction. The sustainability assessment criteria resulting from the survey providea useful bedrock for entities to develop a common understanding in this regards.

- ***R2 Training on sustainability issues, particularly at the level of senior procurement decision makers***

Observations show that there are simply not enough professionals, tradesmen and labourers who have the requisite knowledge and skills to support sustainable construction at the various levels **(**Shafii, 2006; Reffat, 2004).These observations were also noted in some of the interviews conducted. There is, therefore, the need to provide training on sustainability issues at all levels, and particularly at the level of senior procurement decision makers. This can be achieved through the provision of wellstructured guidance

in relation to what is meant by sustainability in the context of construction projects and how it could be implemented. The proposed framework which incorporates some of the research findings could serve this purpose

- ***R3 Evaluating alternative procurement methods/routes in terms of their potential to deliver sustainability objectives***

The procurement route is the contract strategy that delivers the procurement objectives. It includes, among others, Prime Contracting, Design & Build, traditional procurement routes, etc (OGC, 2003). Cost, time and quality have for a long time be the dominant indicators in determining contract strategies in the construction sector with little or no consideration for sustainability. This scenario has been attributed to the lack of clarity regarding whether the different procurement routes have different potential to deliver sustainability requirements (Sourani, 2008). Nonetheless, authors including Love et al, (1998); Ambrose and Tucker, (2000); Alhazmi and McCaffer, (2000), believe that different procurement route has different potentials to deliver sustainability objectives. The importance of identifying the distinct opportunities associated with the different procurement routes to deliver sustainable projects has been stressed (Addis and Talbot 2001).

- ***R4 Ensuring the consideration of a complete range of options to meet organizations infrastructural needs (e.g. refurbishment, new build)***

There are instances where the options for meeting an organisations infrastructure need could include For example, the refurbishment of an existing building. Such an option could result in a more cost effective solution and less negative environmental and social impacts compared with a new build option (Sourani 2008).

- ***R5 incorporating sustainability issues in procurement decision making*** The above role runs parallel with R6, R10 and R11 discussed below.

- ***R6 Promoting corporate social responsibility policy that runs parallel with sustainability***

Corporate Social Responsibility (CSR) shows how a business considers its social, economic, and environmental impacts in its operations and in addressing the firm's own competitive interests as well as that of the wider society (CSR,2005a). According to Glass and Simmonds (2006), growing CSR has the impact of encouraging contractors to improve ethical Standing by responding in a better way to stakeholder expectations.

- ***R7 Sustainability Assessment at various stages of construction procurement*** Developing an assessment-based strategy in terms of sustainability to complement the corporate procurement strategy and the community plan is of much significance to achieving SC (ODPM, 2003).

- ***R8 Priority to re-using previously developed land and reducing consumption of undeveloped land.***

Land is the primary resource requirement in the construction sector. The loss of arable land has been linked to the acquisition and unsustainable use of land for construction activities. In order to minimise the use of green fields, the UK Government has made it clear that preference should be always given to using brown field sites.

- ***R9-Requiring reviews to be conducted to monitor the delivery of sustainability requirements throughout the project life cycle.***

Unless sustainability considerations are actually delivered to the project all other efforts geared towards achieving SC will be futile. It is therefore necessary to have a system in place that monitor the delivery of sustainability requirements all through the project life cycle. The OGC (2005a) highlights the need to conduct periodic review of sustainability

performance during the construction process. Arranging such reviews according to Sourani (2008) needs to be considered during contract preparation

- ***R10-Adopting a balanced approach that ensures the explicit consideration of all sustainability dimensions***

The issue that sustainability was still perceived as an environmental problem, even at the level of senior decision makers has been mentioned in the literature. Sourani (2008) observed that the social dimension of SC in one that has received less attention especially in organisations dominated by economic drivers and the quest for more cost effective solutions. This scenario is a setback to achieving the balance between the social, economic, and environmental dimensions that defines the concept of triple bottom line for sustainable construction.

- ***R11-Ensuring that client organisations have clear policies and guidelines regarding the application of sustainability principles in the procurement of infrastructure***

Research has shown the need for clear policies and guidelines regarding the application of sustainability principles in the infrastructure delivery process in client organisations (Sourani, 2008). Although concerns have been raised over the extra cost that may come along with such policies at the initial stages of implementation, the benefits to be accrued in the long term has been emphasised in the literature.

- ***R12-Improving communication and knowledge sharing within the client organisation regarding sustainability implementation and best practice.***

The importance of establishing links between sustainability and procurement professionals working within the same organisation was mentioned in some of the interviews conducted. Establishing such links would help develop the necessary technical

knowledge needed for appropriate application of sustainability principles in the relevant field.

5.6 Summary

This section presented data analysis and discussed the findings of the research in relationto finding factors that aid in achieving SC, identifying sustainability assessment criteria along social, economic and environmental dimensions of SC and also identifying the role of procuring entities in achieving SC. Data analysis was based on consensus using percentages, mean score and standard deviations as indicators. Validation of initial findings was carried out through interviews with expert in construction procurement.

Ultimately, a set of 12 sustainability factors for achieving sustainable construction was identified. This represents the achievement of objective 1of the research. A set of assessment criteria comprising 13 social assessment criteria, 9 economic assessment criteria and 10 environmental assessment criteria was identified thus achieving objective 2 of the research. Finally, analysis of data from survey 2 yielded 11 sets of factors constituting the role of procurement entities in achieving SC thereby achieving objective 3 of the research.

CHAPTER SIXCONCLUSIONS AND RECOMMENDATIONS

6.1 Introduction

The rational for this research work hinges on furnishing solution to the research problem discussed under section 1.4. Construction activities form part of a broader procurement process which is a demand driven approach to the realization of infrastructural needs of an organization or entity. It is, therefore, very important that every decision, step and approach take along this process focusing on achieving this organizational need —*in a way that achieves value for money on a whole life basis in terms of generating benefits*

not only to the organisation, but also to society and the economy, whilst minimizing damage to the environment now and in the future"

(DEFRA, 2006).This research therefore was aimed at ―Exploring means of achieving sustainable construction along procurement route in the Ghanaian construction industry‖.

In all four objectives were set to achieve this aim. Thus:

- To determine factors in the procurement process that aids in achieving sustainable construction.
- To define criteria for assessing sustainable construction in the procurement process.
- To find the role of procuring entities in achieving sustainable construction.
- To develop a framework for implementation, monitoring and evaluating sustainable construction procurement.

Chapter four described the research methodology used in achieving the first three objectives outlined above. Chapter five presented the data analysis procedures and the validation employed in arriving at the findings. This chapter presents findings of the research with respect to the objectives one, two and three together with a conceptual ―framework for implementation, monitoring and evaluating sustainable construction procurement‖ (objective four). The chapter also shows the contribution of this research to the existing body of knowledge and highlights its limitations. The chapter ends with recommendations for stakeholders in construction procurement in order to be able to advance sustainable construction practices in the procurement of infrastructural works in Ghana.A recommendation for further research is also presented in this chapter.

6.2 Achieving the Aim

Four objectives were set to achieve the aim of the research. In order to fully realize the aim, it was imperative to determine the requisite factors that provide the bedrock for realizing sustainable construction goal (objective 1). Once these factors have been so determined, it remain key to define an assessment criteria for sustainable construction, in terms of social, environmental and economic sustainability: dubbed ―the triple bottom line‖ (see section 2.4.3) along the procurement route (objective 2). Given the role that procurement plays in the realization of the above aim and also for the fact that procurement is initiated from the client's (procuring entity) end, it becomes important to find the role they play so that the whole process becomes a demand driven approach to the realization of the SC goal (objective 3). Finally, it was set in this research to develop a systematic approach that stems from needs identification through to the commission of project for implementation, monitoring and evaluating sustainable construction. This is the objective of the framework (see fig 6.1) which incorporates the survey result together with corroborative data from related studies in the literature review section of this work. Thus the aim of this thesis is achieved accordingly.

6.3 Achieving the objectives

6.3.1 Achieving objective 1: To determine factors in the procurement process that aid in achieving sustainable construction

The first part of questionnaire survey was used to achieve this objective. This led to 12 sustainability factors which were subsequently validated through the semi structure interview The procedures used in determining these factors was described in details in chapter 5 (see sections 5.2.2.1 and 5.4.2). The 12 sustainability factors are presented below:

- *Ensure that contractors have skilled and experienced resources to implement sustainable projects:*
- *Highlighting sustainability in the project brief as a primary aim:*
- *Integrating sustainability requirements into contract specifications and conditions:*
- *Emphasizing the importance of sustainability in tender evaluation and selection procedures:*
- *Incentives for the contractor/supply side to demonstrate commitment to sustainable development through policy and implementation*
- *Contractors should provide Sustainability achievement records and examples of successfully completed sustainable project*
- *Encouraging tenderers to suggest innovative solutions and approaches that support the overall sustainability objectives*
- *Ensuring that payment mechanisms take account of whether sustainability requirements are delivered*
- *Ensuring that sustainability requirements can be clearly assessed and measured*
- *Promoting cultural change towards sustainability throughout the industry*

- *The undertaking of Sustainability risk/impact assessment of construction project.*
- *Provision of a distinct sustainability act for the building sector*

6.3.2 Achieving objective 2 - To define criteria for assessing sustainable construction in the procurement process

As with objective 1 detailed above, questionnaire survey was used to identify initial sets of sustainability assessment criteria which were subsequently validated through the semi structure interviews conducted with experts. This validation approach, led to obtaining more confidence in the results as well as increasing reliability and validity. The process of identifying these factors was described in details in chapter 5 (Section 5.2.3.1and 5.4.3). The assessment criteria are categorized under social, economic and environmental in line with the triple bottom line concept. Details of the findings are presented below.

6.3.2.1 Social Assessment Criteria

The result obtained for social assessment criteria are:

- *Improving health and safety performance*
- *Participation of stakeholders (including community involvement)*
- *Social inclusion (including tackling poverty and social exclusion)*
- *Seeking intergenerational equity by considering cost for future generation*
- *Creating employment opportunities.*
- *Training and development of workforce*
- *Improving working environment and conditions*
- *Consideration of user needs and satisfaction (such as accessibility)*
- *Creating a positive impact on the local environment (e. g. local community, business, infrastructure)*

- *Promoting equitable distribution of costs and benefits (at local, regional and international levels)*

6.3.2.2 Economic assessment criteria

The research yielded the following economic assessment criteria:

- *Clear establishment of need and evaluation of alternative options*
- *Consideration of whole life costing and value for money*
- *Supporting the regional/local economy (including stimulating demand for local labour, businesses, materials and services)*
- *Financial affordability for intended beneficiaries*
- *Competitiveness*
- *Waste reduction and management*
- *Fitness for purpose (e.g. Consideration of long term flexibility*

6.3.2.3 Environmental Assessment Criteria

The environmental assessment criteria include:

- *Selection and use of materials (including specifying low environmental impact materials, re-use and recycling)*
- *Reducing water and energy consumption*
- *Sustainable land use and re-use (including giving priority to re-using previously-developed land and reducing consumption of undeveloped land)*
- *Reusing existing built asset*

- *considering the use of renewable resources (e.g. Renewable energy) and reducing the use of non-renewable resource*

  Minimising water, land and air pollution (including noise)
- *Preserving and enhancing biodiversity*
- *waste minimisation and* management
- *Protecting and enhancing sensitive landscapes (e.g. Valuable scenic and cultural areas)*
- *Creating a healthy, non-toxic internal environment through appropriate specifications and installation (e.g. high indoor air quality)*

6.2.2.3 Achieving Objective 3 - To Find the Role of Procuring Entities in Achieving Sustainable Construction

This objective was achieved using the questionnaire survey which targeted practitioners and experts who are actively involved or responsible for construction procurement in their establishment/organization. All the initial factors identified were confirmed during the interview that followed the exercise. The process of identifying these factors was described in details in chapter 5 (section 5.3.2).The final analysis led to the development of 12 sets of factors that outline the role of procuring entities in the pursuit of SC goals. These are:

- *Procuring entity need a common understanding regarding sustainable construction*
- *Training on sustainability issues, particularly at the level of senior procurement decision makers*
- *Evaluating alternative procurement methods/routes in terms of their potential to deliver sustainability objectives*

- *Ensuring the consideration of a complete range of options to meet organizations infrastructural needs (e.g. refurbishment, new build)*
- *incorporating sustainability issues in procurement decision making*

- *Promoting corporate social responsibility policy that runs parallel with sustainability*
- *Sustainability Assessment at various stages of construction procurement*
- *priority to re-using previously developed land and reducing consumption of undeveloped land*
- *Requiring reviews to be conducted to monitor the delivery of sustainability requirements throughout the project life cycle*
- *Adopting a balanced approach that ensures the explicit consideration of all sustainability dimensions*
- *Ensuring that client organisations have clear policies and guidelines regarding the application of sustainability principles in the procurement of infrastructure*
- *Improving communication and knowledge sharing within the client organisation regarding sustainability implementation and best practice*

6.3.4 Achieving Objective Four -A Conceptual Framework

It is part of the research objectives to develop a conceptual framework for implementing, monitoring and evaluating sustainable construction practice in the Ghanaian construction industry in order to advance the practice of sustainable construction. Figure 6.1 highlight the framework and the various components thereof.

6.3.4.1 The framework

The framework consists of three components: sustainability component (in green outline), procurement component (in cyan outline) and resource component (in orange outline).

Sustainability Component: This component deals with sustainability considerations and inputs throughout the project cycle and shows stages along the procurement route where sustainability interventions are taken.

Procurement Component: The procurement component of the framework is the general construction procurement process, from needs assessment to project commissioning

ResourceComponent:Is the managerial and technical resource factor throughout the procurement chain.

Also, the frameworkdepicts the construction procurement process in three phases:

- Pretender phase
- Tendering phase
- Post tender phase

The pretender phase: This is the stage where the pretender team determines, via the use of critical analysis of information available, the most efficient and cost effective process by which the contract may be progressed and completed. The contract documentation and tender drawings provide a useful starting point. It is seen from the framework that experts are brought in as early as the need assessment stage to advice on sustainability issues so that management are well informed. Also, it provides the opportunity for the top management and other stakeholders to be trained and educated on sustainability issues equipping them to contributing accordingly towards organisation‘s sustainability policies. Here the organisational need is formulated to capture sustainability requirement and assessment in line with organisations cooperate social responsibility policies. The contract brief, conditions, specifications, design, etc. is drafted or prepared in line with the sustainability requirement so determined.

Tendering phase: The tender stage comprises the gathering together of all resources (physical and human) required to carry out the contract. First, tenderers are prequalified through a prequalification notice stating Sustainability requirement to be met. Shortlisted

applicants are then allowed to submit tender for competitive tendering in which predetermined award/ assessment criteria in line with sustainability is to be considered in tender evaluation and selection procedure. A Contract is then awarded on the basis of Most Economically Advantageous Tender (MEAT). The service of the main contractor is then engaged.

Post tender phase: At this stage the contract is awarded the Main contractor – skilled, experienced and well-resourced to meet sustainability requirement, sees to the execution of the contract, together with sub-contractors, in line with contract condition and specification to deliver a sustainable project. The client (procuring entity) and his team of consultants monitor and ensure deliver and progress of sustainability requirement, Evaluate sustainability objectives and send feedback to management

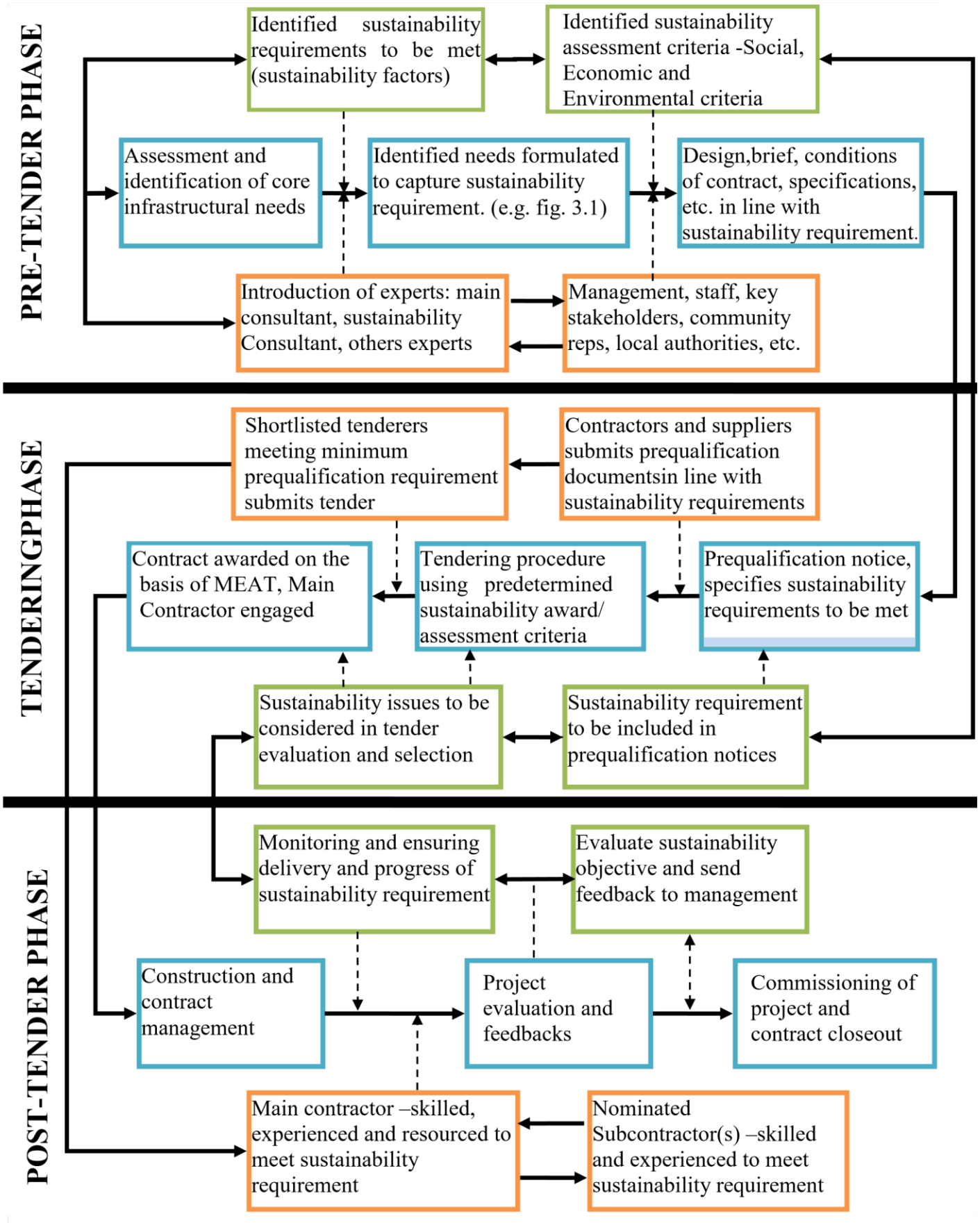

Figure 6.1: Conceptual Framework for Implementing, Monitoring, and Evaluating Sustainable Construction

6.4 Limitations of the Study

This study has certain limitations. These are related to the generic nature of the findings from the study and the number of interviews conducted.

The first limitation is related to the number of validation interviews conducted. As shown under Section 5.4, eleven interviews were conducted with experts and professionals in a variety of professional and public sector organisations. The limited number of the interviewees can be attributed to two main reasons. Firstly, the type of information needed required special expertise in sustainable construction procurement within the public sector and as such, it was difficult to find many experts in the field of study. Secondly, as the interviews focused on confirming the results obtained from the questionnaire survey, the role of the interviews was therefore mainly complementary within the research design.

The second limitation is with respect to the factors resulting from the survey. Most of these factors were gleaned from publication across the globe and therefore not unique to the Ghanaian sector and for that matter economy and so may not adequately address sustainability issues in the local industry. Furthermore,it is worth noting that, not all sustainable factors are applicable to every type of project, due to the complex nature of the construction industry (Ochieng et *al.*, 2014). It is therefore necessary for thorough research and investigative measures to be taken to highlight key issues in the local construction sector in order to facilitate a more pragmatic approach to the realization of SC goal.

6.5 Conclusion and Recommendations

6.5.1 Conclusions

In the end it is established through evolving literature that sustainability provides an avenue for current and future generation to meet their needs within the earth‘s carrying capacity to the realisation of sustainable development goal. It has also been established in the literature the multidimensional nature of sustainability, making it one of the most pursued developmental agenda across the globe. The construction industry‘s capacity to make a significant contribution to sustainable development given that the products resulting from the sector‘s operations are used to reinforce and facilitate all aspects of socioeconomic and environmental affairs has also been established in the literature. The argument for procurement as a tool for realising sustainable construction objective cannot be over emphasised.

In the end the research aim, ―*Exploring means of achieving sustainable construction along procurement route in the Ghanaian construction industry*‖ has been achieved. Recommendations suggested in the following sections are therefore intended to advance the practice of sustainable construction along the procurement route in the Ghanaian construction industry.

6.5.2 Recommendations

Based on the findings obtained in this thesis, recommendations are presented below for the stakeholders who are able to advance the sustainable procurement agenda. These parties include government and regulatory bodies, individual public and private sector Organisations, professional and educational bodies, end users all stakeholders in general. Recommendations are also introduced for further research.

6.5.2.1 Training on Sustainability Issues

Training on sustainability issues at all levels, and particularly at the level of senior procurement decision makers, needs to be provided in private and public sector organisations. This need to involve breaking down the sustainability concept from the abstract level, making more use of examples that could facilitate better understanding of the concept, and providing simpler and more structured guidance. Procuring entities should ensure timely involvement of all project stakeholders, whether internal or external. Communication and knowledge sharing within the client organisation regarding sustainability implementation and best practice have to be improved. Links between sustainability and procurement professionals working within the same organisation should be well established. Work undertaken by public clients in relation to addressing sustainable development in their construction projects should enjoy good publicity (such as in the procurement bulletin) as this can motivate other clients to adopt similar approaches.

6.5.2.2 Emphasise Sustainability at All Stages in the Procurement Process Within their contractual procedures, procuring entities, both private and public, should emphasise sustainability in their project brief, contract specifications and conditions, evaluation and selection procedures. They should encourage the attainment of innovative solutions and approaches from tenderers and should link payment mechanisms to whether sustainability requirements are delivered or not. They should also encourage further integration in the supply chain and promote the adoption of sustainable construction techniques.

6.5.2.3 Implementation, Monitoring and Evaluating Sustainable Construction Client/procuring entities should develop an appreciation of sustainability and the paybacks of more sustainable options and to use the savings, reduced risks and added

value resulting from sustainable construction to offset the extra capital costs that might be required for its implementation. Form partnerships learning with research and education institutions. It is recommended to clients, public and private alike to form consumer lobbying groups in order to advance demand more sustainable products and services and to participate in monitoring and evaluation schemes and to measure cost benefits realised. The framework proposed under section 6.3.4 is recommended for all stakeholders who share the objectives of a sustainable construction industry in Ghana. It incorporates the finding of this research and contains generic approach which is applicable and can be adapted to multiple cases.

6.5.2.4 Recommendations for Further Studies

Research is needed to fill the gapsin relation to the perception of procuring entities in Ghana as to whether sustainability interventions are expensive and to further explore the reasonsthereof. This is necessary in order to furnish motivating factors for action.

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APPENDICES

AppendixA: Survey Questionnaire Part One

AppendixB: Survey Questionnaire Part Two

AppendixC: Interview Structure

Appendix A:Survey Questionnaire Part One

Department of Building Technology,

Collage of Art and Built Environment,

KNUST

University post office,

Kumasi, Ghana.

Dear Sir/Madam

Invitation to partake in a Research Survey

I am undertaking a research studies at the KNUST. The title of the research project is ―Achieving Sustainable Construction through Procurement in the Ghanaian construction industry‖. The research aims at ―exploring means of achieving sustainable construction along procurement rout in the Ghanaian construction industry‖

Attached is a copy of my questionnaire. I would be very grateful if you could find time to complete the questionnaire which should take no longer than 20minutes.

Before you complete the questionnaire I can confirm that:

- Your anonymity will be maintained at all times and no comments will be ascribed to you by name in any written document or verbal presentation. Nor will any data be used for the interview that might identify you to a third party.

- You will be free to withdraw from the research at any time and/or request that your questionnaire not be used.

- On completion of the research, a copy of the final research report will be made available to you upon request.

I sincerely hope that you will be able to help me with my research. If you have any queries concerning the nature of the research or are unclear about the extent of your involvement in it please contact me at paintsildaniel@gmail.com

Finally, mayI thank you once again for taking the time to consider my request and I look forward to your reply.

Yours sincerely,

.....

Daniel Paintsil

SURVEY QUESTIONNAIRE (TO BE COMPLETED BY PROFESSIONALS IN CONSTRUCTION PROCUREMENT AND ALLIED FIELDS)

The Questionnaire

The aim of the questionnaire is to get the opinion of professionals in construction procurement and allied fields in Ghana about achieving sustainable construction procurement. All responses to this questionnaire will be treated in strict confidence. The information provided will only be used for the research project purposes. Neither individuals nor their organisations will be identified in any results produced. Thank you very much for your time and effort.

SECTION A: RESPONDENT'S BACKGROUND

Please select from the alternativesprovided the option that best answer the questions below

1. What is your academic qualification ☐

(A) Undergraduate ☐ (B) graduate ☐ (C) post graduate ☐ (D) other ☐

2. Your professional expertise is

(A) Engineer (various fields) ☐ (B) architect/designer (C) quantity surveyor/estimator ☐

(D) Specialist consultant (such as construction arbitrator, sustainability consultant, etc. ☐

(E) Other (specify please).....

3. What is the nature of the establishment you work under?

(A) Construction consultancy and related services ☐

(B) Building/civil construction and related works ☐

(C) Think-tank, research and academic institution ☐

(D) Public agencies/departments and regulatory institutions ☐

(Such as MDAs, MMDAs, EPA, Town and country planning dept. etc.)

(E) Other, (please specify in space below)

☐

4. How long have you been in the construction procurement and allied fields

(A) Up to 5yrs (B) 6-10 yrs.(C) 11 -20 yrs.(D) 21-30 yrs.(E) Over 30

5. Relevant experience in the fields of construction procurement and allied fields

SECTION B: FACTORS THAT AID IN ACHIEVING SC

The table below shows some factors identified in literature that aids in achieving sustainable construction (SC) procurement. Select (using the scale below) as many as applicable factors which in your opinion will be relevant to the Ghanaian construction sector in achieving SC goals.

Scale: 1= Not Important, 2= Slightly Important, 3= Moderately Important, 4= Very Important, 5=Extremely Important

Col. A	Colum B	Colum D				
CODE	SUSTAINABILITY FACTORS	SCORE				
F1	Ensure that the contractors have skilled and experienced personnel and resources to implement sustainable projects	1	2	3	4	5
F2	Highlighting sustainability in the project brief as a primary aim					
F3	Integrating sustainability requirements into contract specifications and conditions					
F4	Emphasising the importance of sustainability in tender evaluation and selection procedures					
F5	Incentive for the contractor/supply side to demonstrate commitment to sustainable development through policy and implementation					
F6	Requiring the supply side to demonstrate capability of delivering sustainability requirements					
F7	Contractors should provide Sustainability achievement records and examples of successfully completed sustainable projects.					

F8	Encouraging tenderers to suggest innovative solutions and approaches that support the overall sustainability					
	objectives					
F9	Ensuring that payment mechanisms take account of whether sustainability requirements are delivered					
F10	Ensuring that sustainability requirements can be clearly assessed and measured					
F11	Promoting cultural change towards sustainability throughout the industry					
F12	Undertaking of Sustainability impact assessment on construction project					
F13	Allowing sufficient time in programs to address and assess sustainability issue					
F14	Provision of a distinct sustainability act for the building sector.					

SECTION C: CRITERIA FOR ASSESSING SUSTAINABLE CONSTRUCTION

The table below show some criteria under social, economic, and environmental dimensions of sustainability in the construction industry. Select (using the scale below) as many as applicable criteria which in your opinion should be considered in assessing

SC at the various stages of the construction procurement process in the Ghanaian construction sector.

Scale:

1= Not Important, 2= Slightly Important, 3= Moderately Important, 4= Very Important, 5=Extremely Important

Col. A	Colum B	Colum C				
CODE	CRITERIA	SCORE				
A. Social Assessment Criteria		1	2	3	4	5
A1	Improving health and safety performance					
A2	Participation of stakeholders (including community involvement)					
A3	Social inclusion (including tackling poverty and social exclusion					
A4	Seeking intergenerational equity by considering cost for future generation					
A5	Creating employment opportunities					
A6	Training and development of the workforce					

A7	Improving working environment and conditions					
A8	Equality and diversity in the Workplace					
A9	Consideration of user needs and satisfaction (such as accessibility)					

A10	Creating a positive impact on the local environment (e. g. local community, business, infrastructure)					
A11	Preservation of culture and heritage					
A12	Minimising the disruptive impacts of construction (e. g. noise)					
A13	Promoting equitable distribution of costs and benefits (at local, regional and international levels)					
A14	Building and maintaining social capital					
B. Economic considerations						
B1	Clear establishment of need and evaluation of alternative options					

B2	Consideration of whole life costing and value for money					
B3	Supporting the regional / local economy (including stimulating demand for local labour, businesses, materials and services)					
B4	Financial affordability for intended beneficiaries					
B5	Competitiveness					
B6	Waste reduction and management					
B7	Consideration of effective logistics strategies					

B8	Improving the efficiency of the supply side					
B9	Fitness for purpose (e.g. consideration of long term flexibility)					
C. Environmental considerations						
C1	Selection and use of materials (including specifying low environmental impact materials, re-use and recycling)					

C2	Reducing water and energy consumption					
C3	Sustainable land use and re-use (including giving priority to re-using previously- developed land and reducing consumption of undeveloped land)					
C4	Reusing existing built asset					
C5	Considering the use of renewable resources (e.g. renewable energy) and reducing the use of nonrenewable resource					
C6	Minimising water, land and air pollution (including noise					
Environmental considerations contd.		1	2	3	4	5
C7	Preserving and enhancing biodiversity					
C8	Waste minimisation and management					
C9	Protecting and enhancing sensitive landscapes (e.g. valuable scenic and cultural areas)					
C10	Creating a healthy, non-toxic environment (e.g. high indoor air quality					

C11	Minimising - negative visual impact					
Other observed criteria below please.						

SECTION D: COMMENTS

Please add any comments you would like to make regarding any of the items in the questionnaire. It will be also helpful if you could provide any details regarding any cases where sustainable construction has been addressed adequately. (Supplementary sheet attached)

End of survey. Thank you very much for your cooperation

SUPPLEMENTARY SHEET

Definitions and Clarifications (sent with the questionnaire)

Definitions and clarifications are provided below to clarify some of the terms used in the questionnaire.

Sustainable Construction is a construction process that incorporates the basic themes of sustainable development, taking into account environmental, social and economic considerations referred to as the ―triple bottom line‖.

- Social sustainability deals with legal, moral and ethical obligations of construction organizations to their stakeholders.
- Environmental sustainability on the other hand addresses the impact of construction activities on the environment by minimising waste, using natural resources and energy efficiently.
- Economic sustainability, however involves improved project delivery resulting in high productivity to maintain a high and stable level of economic growth

Sustainable development is ―Development that meets the needs of the present without compromising the ability of future generations to meet their own needs-a process of change in which the exploitation of resources, the direction of investments, the orientation of technological development, and institutional change are all in harmony and enhance both current and future potential to meet human needs and aspirations.‖ [World Commission on Sustainable Development, 1987]

The construction industry is defined as the sector of an economy which plans, design, construct, alter, maintains, repairs and eventually demolishes buildings of all kinds, civil engineering works and structures and includes building materials manufacturers and suppliers as well as clients and end use occupiers.

Procurement is the overarching function that describes the activities and processes to acquire goods, works and services. It includes the activities involved in establishing fundamental requirements, sourcing activities such as market research, evaluation and negotiation of contracts. Procurement is often carried out by the process of tendering, rather than buying products directly from a seller

Improving workforce satisfaction: This refers to attending to the issues that affect the quality of the construction workforce's working life - of working conditions, reward, quality of the management etc.

Seeking Intergenerational equity by considering cost for future generations: This refers to attempting to achieve equity between generations and ensuring that significant social, biophysical and financial costs of current construction are not passed on to future generations.

Social exclusion is a broader concept and encompasses some of the wider causes and consequences of deprivation. It is what can happen when communities suffer from a combination of linked problems such as unemployment, poor skills, low incomes, discrimination, poor housing, high crime, bad health and family breakdown etc.

Stakeholders are the named individuals and groups who have an interest in, or are involved in, or who are affected by, the activities and outcomes of a change initiative.

Appendix B:Survey Questionnaire Part Two

Department of Building Technology,

Collage of Art and Built Environment,

KNUST

University post office,

Kumasi, Ghana.

Dear Sir/Madam

Invitation to partake in a Research Survey

I am undertaking a research study at the KNUST. The title of the research project is ―Achieving Sustainable Construction through Procurement in the Ghanaian construction industry‖. The research aims at ―exploring means of achieving sustainable construction along procurement route in the Ghanaian construction industry‖

Attached is a copy of my questionnaire. I would be very grateful if you could find time to complete the questionnaire which should take no longer than 20minutes.

Before you complete the questionnaire I can confirm that:

- Your anonymity will be maintained at all times and no comments will be ascribed to you by name in any written document or verbal presentation. Nor will any data be used for the interview that might identify you to a third party.
- You will be free to withdraw from the research at any time and/or request that your questionnaire not be used.
- On completion of the research, a copy of the final research report will be made available to you upon request.

I sincerely hope that you will be able to help me with my research. If you have any queries concerning the nature of the research or are unclear about the extent of your involvement in it please contact me at paintsildaniel@gmail.com

Finally, may I thank you once again for taking the time to consider my request and I look forward to your reply.

Yours sincerely,

.....

Daniel Paintsil

SURVEY QUESTIONNAIRE (TO BE COMPLETED BY PROCUREMENT PRACTITIONERS IN BOTH PUBLICK AND PRIVATE ORGANIZATION/INSTITUTION)

The Questionnaire

The aim of the questionnaire is to get the opinion of professionals in construction procurement and allied fields in Ghana about achieving sustainable construction procurement. All responses to this questionnaire will be treated in strict confidence. The information provided will only be used for the research project purposes. Neither individuals nor their organisations will be identified in any results produced. Thank you very much for your time and effort.

SECTION A: RESPONDENT'S BACKGROUND

Please select from the alternative below the option that best answers the questions below

1. What is your academic qualification

(A) Undergraduate ☐ (B) graduate ☐ (C) post graduate ☐ (D) other ☐

2. What is the nature of the establishment you work under?

(A) Local authority (Such as MMDAs) ☐

(B) Education ☐

(C) Health ☐

(D) Financial/Business organization ☐

(E) Other private establishment, (please specify in space below)

.....

(F) Other public establishment, (please specify in the space below)

……

3. How long have you been in the procurement and allied profession?

(A) Up to 5yrs ☐ (B) 6-10 yrs ☐ (C) 11 -20 yrs ☐ (D) 21- 30 yrs(E) over 30 yrs ☐

4. Any Relevant Experience in construction procurement and allied fields?

SECTION B: ROLE OF PROCURING ENTITIES IN ACHIEVING SUSTAINABLE CONSTRUCTION.

The table below shows some factors identified in literature that outlines the *role of procuring entities in achieving sustainable construction*. Indicate your extent of agreement to each factor using the scale below that which in your opinion will be relevant to the Ghanaian construction sector in achieving SC goals.

Scale: 1= strongly disagree, 2= disagree, 3= neither agree nor disagree, 4= agree, 5=strongly agree

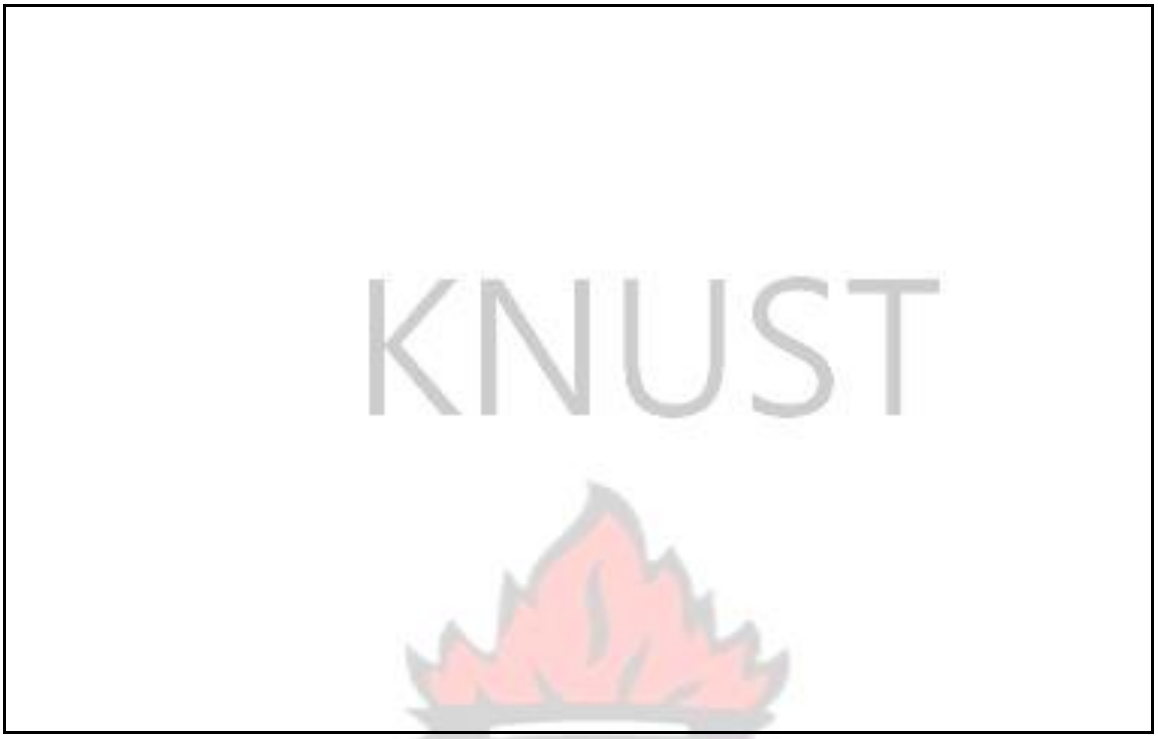
Role of entities

CODE	FACTORS	SCALE				
R1	Procuring entity need a common understanding regarding sustainable construction	1	2	3	4	5
R2	Training on sustainability issues, particularly at the level of senior procurement decision makers					
R3	Evaluating alternative procurement methods/routes in terms of their potential to deliver sustainability objectives					
R4	Ensuring the consideration of a complete range of options to meet organizations infrastructural needs (e.g. refurbishment, new build)					
R5	incorporating sustainability issues in procurement decisionmaking					
R6	Promoting corporate social responsibility policy that runs parallel with sustainability					
R7	Sustainability Assessment at various stages of					
	construction procurement					
R8	priority to re-using previously developed land and reducing consumption of undeveloped land					
R9	Requiring reviews to be conducted to monitor the delivery of sustainability requirements throughout the project life cycle					

R10	Adopting a balanced approach that ensures the explicit consideration of all sustainability dimensions					
R11	Ensuring that client organisations have clear policies and guidelines regarding the application of sustainability principles in the procurement of infrastructure					
R12	Improving communication and knowledge sharing within the client organisation regarding sustainability implementation and best practice					
Other observed factors for procuring entities below please.						

SECTION D: COMMENTS

Please add any comments you would like to make regarding any of the items in the questionnaire. It will be also helpful if you could provide any details regarding any cases where sustainable construction has been addressed adequately. (Supplementary sheet attached)



End of survey. Thank you very much for your cooperation

SUPPLEMENTARY SHEET Definitions and Clarifications*

* Refer to Appendix A

Appendix C:Interview Structure

Department of Building Technology,

Collage of Art and Built Environment,

KNUST

University post office,

Kumasi, Ghana.

Dear Sir/Madam

Invitation to partake in a Research Survey

I am undertaking a research study at the KNUST. The title of the research project is ―Achieving Sustainable Construction through Procurement in the Ghanaian construction industry‖. The research aims at ―exploring means of achieving sustainable construction along procurement route in the Ghanaian construction industry‖

I was wondering if your circumstance would favour an interview session, at a time and place convenient to you as part of the research. The interview should take no longer than 20 minutes.

Before you agree to the interview I can confirm that:

- The Head of the Building technology department has given permission for this research to be carried out. (attestation attached)
- With your permission the interview will be recorded.
- Your anonymity shall be maintained at all times and no comments will be ascribed to you by name in any written document or verbal presentation, nor will any data be used for the interview that might identify you to a third party.
- You will be free to withdraw from the research at any time and/or request that your transcript not be used.

I will write to you on completion of the research and a copy of my final research report will be made available to you upon request. A copy of the interview structure is attached for your consideration

You have valuable expertise to the research project and I would very much like to know your views about the subject. I sincerely hope that you will be able to help me with my research.

If you have any queries concerning the nature of the research or are unclear about the extent of your involvement in it please email me at paintsildaniel@gmail.com

Finally, may I thank you once again for taking the time to consider my request and I look forward to your reply.

Yours sincerely,

.....

Daniel Paintsil

INTERVIEW STRUCTURE

Section A: General Information

This section will solicit information about the interviewee‘s background such as area of expertise and Relevant Experience in the fields of construction procurement and allied fields.

Section B: Factors that aid in Achieving Sustainable Construction (SC)

This section will dwell on factors in the construction procurement process that provide avenue for realising SC goals.

Section C: Criteria for Assessing SC

Criteria for assessing SC under social, economic, and environmental dimensions of sustainability in the construction industry will be the focus of this section

Section D: The Role of Procurement Entities in Achieving SC

Finally this section of the interview will be to explore what role procuring entities can play in achieving SC.

Definitions and Clarifications*

* Refer to Appendix A