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Towards an Uptake Framework for the Green Building Concept in Ghana: A Theoretical Review

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Abstract

The Green Building Concept (GBC), has become a topical issue and is receiving global attention as a potential solution to numerous adverse effects of construction activity both climatically and environmentally. Globally, the construction industry alone consumes 50% of all resources, 45% of all Energy and adds to 35% of CO_2 emissions. Several developed countries has embraced the GBC as the most formidable solution to the preservation of their natural resources and cutting down on the negative impacts of construction on the climate and environment. However, uptake of the concept in the Ghana Construction industry is very minimal and not at the desired rate with only four (4) certified green buildings. This creates a fragile environment which undermines Ghana's efforts at realizing the Sustainable Development Goals (SDGs).

A critical review of literature is conducted exploring the implementation of the GBC in Ghana. Through discussions, the research established the present status of the practice in Ghana as well as the drivers responsible for this current state. The implications of these drivers in the Ghana construction industry are discussed as well. For an increased uptake of the concept in Ghana and Sub-Saharan Africa (SSA), key measures to ensure rapid uptake are recommended to include; a national education, awareness and publicity campaign, the imposition of mandatory government regulations and policies and the provision of financial and market-based incentives amongst others.

Keywords

Green building concept; Ghana construction industry; Rating tools; Implementation; Drivers; Uptake; Promotion Strategies;

1. Introduction

The world population has increased significantly over the last century, rising from 1 billion in 2000 to 7 billion in 2011 (UNFPA, 2017). Current global population according to the UNFPA (2017) is estimated at 7.5 billion people with an indication that it will increase to about 10 billion people the year 2050. The increasing population coupled with rapid urbanization globally, demands more physical developments to provide the shelter needs of humans.

As such, global construction industry has the critical duty of meeting the shelter needs of the fast growing population of the world. World Economic Forum (2013) posits that to support a projected global population of 9 billion by 2050, an estimated US$ 5 trillion per year needs to be invested in global infrastructure. Aside the investment requirement of the construction industry in meeting the world shelter needs, we need to be mindful of, particulars as we seek to achieve sustainable buildings, of the adverse effects of the industry's activities on global climate and environment.

A review of literature reveals weighty impacts of the industry's activities on the natural climate and environment, national economies, as well as public health and productivity. Globally, the construction industry's market volume amounts to over US$ 3 trillion and is responsible for upto about 10% of Gross Domestic Product (GDP) (UNEP 2003; 2007). Further, in Europe, Construction is the largest industrial sector with 10-11% of GDP whilst in the US, its responsible for 12%. It is also responsible for 2-3% of GDP in developing countries. The Industry is noted to be responsible for over 50% of national capital investment in several countries. In terms of employment, 7% employment globally is provided by construction sector employing upto 111 million people. Zuo and Zhao (2014) alludes to this with the assertion that, the industry is responsible for 7.5% of GDP and employs over 1 million people in Australia. In Ghana, the industry yields upto 11.8% of GDP and employs about 3.1% of the workforce (GSS, 2014). According to AfDB Group (2013), the industry's support to GDP progression in Ghana has been increasingly progressive, thus performing better than manufacturing and other industries of the economy.

Notwithstanding these positive impacts of the construction industry, there exist a lot of recognized deleterious effects of construction activity on the climate, environment and national economies as well (Zhang et. al, 2011). As a result of the nature of construction, it is noted as one that uses a lot of materials, natural resources, energy, and water and pollutes offensively (Evins, 2013). Globally, Construction industry consumes 50% of all resources, 45% of all energy, 12-16% of total water, 60% of prime agricultural land, and 70% of all timber products on construction and maintenance of the built environment (UNEP 2003; Pulselli, R., et al. 2007; UNEP 2007; WBCSD 2007; UNEP 2009; Xing et al. 2011; Berardi 2013). Added to the consumption of resources, the construction industry emits 35-40% of global CO_2 and produces upto 65% of waste materials dumped in landfills (UNEP 2007; Yudelson 2008; Wu and Low 2010; Son et al. 2011; AlSanad 2015). Wu et al. (2014) as well as Zuo et al. (2015) both support the assertion that the construction industry is a major contributor to CO_2 emissions because it utilizes a substantial quantity of energy globally. A further 18% of emissions are reported to emanate from the disposal of buildings at the end of thier life spans (UNEP 2007; Yudelson 2008; Zuo & Zhao 2014). In confirmation of these impacts in relation to Ghana, Dzokoto et al. (2014), posits that, construction is a sizeable contributor to environmental degradation in Ghana with the existence of unsustainable designs and construction methods and processes. The negative impacts of the industry on both environment and the populace are grave and distressing and has thus increased wide-reaching awareness of the importance of sustainable construction (Wang et al. 2014).

Globally, building design has emerged as a formidable vehicle through which the construction industry can help enhance the environment instead of exploiting it. Governments in the developed world in response has enacted laws and Acts and adopted some measures to minimize the adverse effects of construction on the environment including; promoting new construction as well as retrofitting existing buildings to satisfy low energy criteria using the GBC (Ahn et al. 2013). Al-Kaabi et al. (2009) in support notes that many countries have embraced the GBC as the best tool for the preservation and sustainance of their environment and resources. It is worth noting that, in many of the developed countries, Governments have enacted regulations and laws aimed at promoting the practice of green building and also established standards to guide the practice (Hwang & Tan, 2012). For instance, the US government has made it compulsory to meet the requirements of the Leadership in Energy and Environmental Design (LEED) in all buildings by passing the Green building legislation (Renewable Energy World, 2005). Smilarly, every building in every European Union (EU) country s required was required to meet a specific energy performance standard and be certified by the year 2006 as a result of the Energy Performance of Buildings Directive (EPBD) which was passed then (EPBD, 2009).

Furthermore, many governments in the developed world are using advocacy and devising strategies for wider adoption of GBC (Darko et. al 2016). Governments in the US, UK, and Canada have formulated incentive policies such as mortgage loans and discount loans to stimulate the uptake of green features as well as technologies (Qian and Chan, 2010). Consequently, the Government of Singapore has in line with a target set to green 80% of the country's building stock by 2030, taken various initiatives, including providing about $100 million fund for developers to retrofit their buildings to meet green standards and $20 million to help owners, developers, and other relevant stakeholders implement GB technologies and practices in sustainable building design (Low et al., 2014).

Sharply contrasted to this deliberate practice by the advanced world, where legislations and Acts have been passed to promote the uptake of the GBC, most developing countries in Sub-Saharan Africa including Ghana have limited or no such legislation and therefore, the adoption of the concept is at the discretion of the various industry practitioners and stakeholders. The Ghana Green Building Council (GhGBC) exists as a member-based Non-Governmental Organisation (GHGBC 2016). Its operations since establishment has been largely limited to education and publication of the GBC as a national framework that will create a combined enabling environment for the construction and execution of sustainable building construction undertakings. However, involvement of the government, the general public and private sectors in GBC is conspicuously absent. Consequently, this review paper aims to theoretically explore global green building efforts, trace the progress of the uptake of the green building concepts in Ghana and establish the present level of uptake of the GBC in the GCI. This paper further reviews the driving forces of green building uptake and discusses the implications for the Ghana construction industry. This paper concludes by recommending measures to employ in other to propel uptake and implementation of GBCs in SSA, particularly the activities of the built environment in Ghana.

1.1. Research Methodology

This paper adopts the literature review method to establish what GB is and worldwide efforts at its establishment. Through discussions, this paper theoretically assesses the status of the practice in Ghana, which drivers are dictating this pace of uptake and their implications to the Ghana construction industry. Measures to employ to ensure speedy and widespread uptake of the GBC in the Ghana construction industry are recommended.

The progression of knowledge on particular topics has resulted in the applicaion of literature review as a methodology in construction management research in several instatances (Chan et al., 2004; Li, Shen, & Xue, 2014). With its epistemology aligned with interprevist-construction, the review of literature is a methodology on its won Kitchenham, 2004; Victor, 2008; and Tuli, 2010). In addition, the review of related literature on a particular topic usually is a tool for advancing knowledge of the topic since it aids the development of theories relevant to research and practice (Webster and Watson, 2002).

The study started by first identifying a credible and well known electronic databases; Google scholar, Research Gate, and Science Direct. High impact journals on green building, sustainable construction, green infrastructure, high-performance building, environmental design and construction were accessed in the process. This was followed by a preliminary desktop search to extract related articles from mainly peer reviewed journals for the review.

For the purpose of obtaining a large coverage of search results, the initial descriptors used in this review was mabe up of synonyms and terms that are related to the concept under review. The desciptors employed include 'green building', 'green construction', 'sustainable construction', 'sustainable building', green building implementation in Ghana, 'drivers', 'benefits', 'motivations', and 'strategies' (See table 1). It must be noted that, conisdering all the possible descriptors in a single study of this nature is not practical (Darko and Chan, 2016). As such other studies could consider other keywords using the same methodology in future.

An initial search of related articles published between 2000 to 2018 was therefore conducted resulting in the extraction of upto 436 papers (from February 2017 to April, 2018). It was however realised that, some of the articles did not present studies on GB implementation and related drivers since some of them had only some of the descriptors in their titles or abstracts. A filtering process was thus conducted by briefly reviewing the abstracts of these papers. After filtering, about 66 related full text articles found to be relevant were used for this review. This paper is therefore focused on the review and drawing of conclusions on the green building implementation issues and related drivers acquired from the methodology adopted. Its not an assessment of all the articles on the topic.

Table 1. Listof electronic databases, keywords and key journals used for review

Electronic database	Descriptors for literature search	Key journals accessed
Google scholar Research gate ScienceDirect Some websites	Green building Green construction Sustainable building Ssustainable construction Green building in Ghana Drivers Benefits Motivations Strategies Construction in Ghana	Journal of Green Building Sustainable Development Renewable and Sustainable Energy Reviews Habitat International Building and Environment J. Management Engineering J. Cleaner Production Sustainable Cities and Society J. Technology Management in China Int. J. Sustainable Building Tech. Sustainability Building and Environment, National Water Policy

1.2. Green Building: What is it and how did it come about?

Due to the global appeal for the GBC, it has received a lot of attention from many researchers hence many definitions exist for green building. The term "green building" is often used interchangeably with the terms sustainable construction, and high-performance buildings, within the construction industry (Zuo & Zhao, 2014; Rajendran, Gambatese, & Behm, 2009; EPA, 2008; Kibert, 2012).

Whilst Hwang & Tan (2012), define green building as a building that is energy and resource efficient and has minimal disruptions to the environment, Gamatese et al. (2009), describes green building as that which addresses primarily the design and construction practices that impact the environment. The latter definition is however observed to be a bit deficient in that, it does not embody all the elements of the construction process. It limits its scope to the design and construction practices. Hence, a differing definition by Kibert, (2008), describes green building as the creation and responsible management of a healthy built environment based on resource efficiency and ecological principles. This is consistent with the definition by the CIB (2002) which posits that, green building means "applying the principles of sustainable development to a comprehensive construction cycle from the extraction and beneficiation of raw materials, through the planning, design, and construction of buildings and infrastructure, until their final deconstruction and management of the resultant waste". It is also supported by Henn & Hoffman (2008) who defines green building as a term that embodies strategies, techniques, and construction products that are less resource-intensive or pollution-producing than regular construction. This is similar to descriptions by both Yudelson (2008) and Lausten (2008) to the effect that, green building is one that has minimal impacts on health and environment and designed to include natural and material resources efficiency, and water and energy efficiency. Here the scope embodies the methods, materials, resource efficiency and less impact on the environment.

Geng et al (2012), observes that, Green building is such an effort because it can reduce the use of resources such as electricity, gas and water by using energy-efficient appliances and systems and reduce waste by using long-lasting products such as recycled carpet, natural linoleum and bamboo flooring. This is consistent with Kats (2003), who describes Green Buildings as buildings that use key resources like energy, water, materials, and land more efficiently than conventional buildings that are just built according to codes and regulations.

Perhaps a more comprehensive description is that by the U.S Environmental Protection Agency (EPA, 2013) which define green building as "the practice of creating structures and processes that are environmentally responsible and resource-efficient throughout a buildings life-cycle from siting to design, construction, operation, maintenance, renovation, and deconstruction." The scope embodies almost all the aspects of the construction cycle, methods, resource-efficiency and environmental impact. However, it is silent on material specification.

In this study, green building is defined as the planning, siting, design and construction of buildings by the use of resource-efficient materials and methods which will have less impact on the health of the environment, as well as the associated health and well-being of the buildings' occupants, construction workers, the general public, and future generations throughout the life cycle of the building.

GB development actually pre-dates the ancient days of human race; particularly ancient Babylonians and Egyptians where the indigenous people used natural materials of stone, wood, grass and leaves as well as leather that was locally available to them to construct buildings to provide shelter against wild animals and exclude them from the weather (Kubba, 2017). Conscious efforts of GB development emanated from the US and Europe in the 1970's. The kick-start it needed to start came in 1973 following an oil embargo placed by Organization of Petroleum Exporting Countries (OPEC). High rise in gas prices coupled with the long ques at the gas stations caused Americans to question the rationale behind the U.S relying heavily on foreign fossil fuels for transportation and building (Kubba, 2017).

Hence the GBC was first a response to the oil embargo as the panacea for reduced energy consumption to stabilise the difficult energy market then after the oil embargo. Stakeholders progressively gave serious attention to GB development as a novelty that will do away with the adverse impacts of buidling on the environment including the extreme water and energy consumption (Retzlaff, 2009). Resulting from this, stakeholders now use GB to achieve low carbon construction towards sustainability (Chan et al. 2009: Son et. al 2011; AlSanad 2015). For a building to be considered a GB, its design and construction are so as to achieve positive environmental performance and assessed using GB rating tools, which also comprise environment related criteria such as sustainable sites and transport, energy and water efficiency, environmentally friendly materials, indoor air quality improvement (Say & Wood, 2008; Braune, 2011; Mpakati-Gama et al., 2012; Ozolins et al., 2010). There is general agreement in literaure that the benefits of GB include health improvement of occupants, resource efficiency, and waste reduction during the building lifecycle (Liu et al., 2014; Darko, Chan, Owusu-Manu, & Ameyaw, 2017; Darko, Chan, Owusu, & Antwi-Afari, 2018;). GB has been believed to bring direct economic benefits to their owners as they are able to save lifecycle costs, improve occupant productivity and performance, and increase their competitive advantage (Kats, 2003; Ries, Bilec, Gokhan, & Needy, 2006; Liu et al., 2014; Qian et al., 2015). As an innovation, GB is proved that it has increased average rents and prices' value of early adopters more than that of later entrants (Kats, 2003). Environmentally, the UNEP, 2016, in a study notes that, the emissions savings potential of GB can be as much as 84 gigatonnes of CO_2 ($GtCO_2$) by 2050, through direct measures in buildings such as energy efficiency, fuel switching and the use of renewable energy. At the building level, GBs achieving the Green Star certification in Australia have been shown to produce 62% fewer greenhouse gas emissions than average Australian buildings, and 51% less potable water than if they had been built to meet minimum industry requirements whilst their counterparts achieving the Green Star certification in South Africa have been shown to save on average between 30 - 40% energy and carbon emissions every year, and between 20 - 30% potable water every year, when compared to the industry norm (World Green Building Council (WGBC, 2017). These noticeable and immaterial benefits that GB achieves, has driven the inertia high and the GB movement has become a global trend.

Over the years, the global appeal for GB has led to the introduction of guidelines and frameworks with the aim of providing a level platformin terms of unifromity of stands for the application of sustainable practices as well as the acceptance. Building Research Establishment Environmental Assessment Method (BREEAM) was the first GB guideline presented to the world in the U.K in 1990 (BRE 2007 as cited in Potbhare et al., 2009). Following closely on its heels is the Leadership in Energy and Environmental Design (LEED), a credit based GB rating system implemented since 2000 by the U.S. Some other guidelines include the Building Environmental Assessment Method (BEAM) of Hong Kong, Comprehensive Assessment System for Building Environmental Efficiency (CASBEE) of Japan, , Green Star of Australia, Green Globes in Canada and US, Green Mark in Singapore, TERI-GRIHA in India, Green Building Index of Malaysia ,and Green Star SA of South Africa amongst others. Say & Wood (2008), explains that despite a few variations to allow for climate or cultural differences within each specific system and region, these rating tools are built on mainly six (6) principles; energy efficiency, selection and development of site, resource conservation, indoor air quality, material conservation and efficiency, and water efficiency. (See table

2 for characteristics of the major rating tools in use). A lot of literature abounds in support of the fact that, the rating tools and guidelines have played a key role in advancing the implementation of green practices and concepts (Windapo, 2014: Wang & Ye, 2013).

These rating tools and guidelines are developed, owned and managed by the respective local green building councils the activities of which are harnessed by the global network, World Green Building Council (WorldGBC). Founded by David Gottfried in the year 2002, the WorldGBC currently comprises over ninety-five (95) countries in three membership levels (Prospective, Emerging and Established) (WorldGBC, 2017). The WorldGBC (2017) states its mission as "to create green buildings for everyone, everywhere - enabling people to thrive both today and tomorrow". Leading members of the global network include; the United States Green Building Council (USGBC), Green Building Council of Australia (GBCA), Canada Green Building Council (CaGBC), UKGBC etc. (see table 2 below for the year of establishment and tools developed with numbers of buildings rated). It is noted that, the efforts of these global networks positively impacted the momentum of uptake of global GB practices. A consistent increase in the number of international sustainable building organisations as well as the number of projects registering and requiring certification in the past 15 years has been recorded. This according to Reeds et al., (2011), indicates success in the progress of the initiative. The GhGBC was established in 2011 and is making strides at enhancing the development of green building as far as Ghana's built environment is concerned through education. It has adopted the Green Star SA rating tool and modified it into Green Star SA – Gh for use in Ghana. The following sections will delve into the growth of GB in Ghana's construction industry and take a look into the issues driving these development with their implications for the uptake of the GBC in Ghana. It would be concluded with recommended strategies for improving the uptake of the GBC in Ghana since the concept is still relatively new within the industry.

Source: compiled from usgbc, gbca, ukgbc, breeam, ghgbc (as at September, 2017).

1.3. The Ghana Construction Industry in brief

The construction industry is regarded as relevant to development and a mainspring for economic growth (Anaman and Osei-Amponsah, 2007; Agbodjah, 2008). According to Laryea (2010), Ghana is a renowned emerging market in SSA and this is largely in part due to a vibrant construction industry. Ghana has a construction industry which is mainly dominated by residential and commercial office properties, and a large percentage of this takes place in the capital city, Accra. The industry annually yields upto 10% to GDP and provides employment for upto 10% of the working population (Ofori, 2012). Despite this important position of the construction industry, it is observed that, the national housing deficits has persisted since Ghana's independence. Growing from a housing deficit of 52536 units in 1960 to an estimated 1.7 million units in 2017, the problem is noted to have worsoned (Centre for Affordable Housing Finance in Africa, 2017). Ilamura (2013) notes that if this deficit is not met shortly, it could grow to two million by the year 2020. As such there is the need for a sustainable action plan to meet this housing challenge.

Dadzie et al., (2012) notes that the GCI is multifaceted and has a wide mix of stakeholders who play various roles. The stakeholders involved include; The Client Community – public and private sectors, the Design Community, the Supply Chain (Materials Suppliers, Machinery Manufacturers, and Sub-assemblers), Main Contractors and Sub-Contractors, Universities, technical institutions and Professional associations, Economic drivers such as Banks and other financial corporations, and Trade Unions, including regulation and standards authorities (Agbodjah, 2008; Osei, 2013). All these often play different roles to achieve a project in Ghana. The activities of the stakeholders as stated are managed by the Ministry of Water Resources, Works and Housing (MWRWH) which is responsible for housing infrastructure, and the Ministry of Transportation (MoT) which regulates the roads and civil related infrastructure sector. MWRWH is responsible for the formulation and co-ordination of policies and programmes for the development of the country's infrastructure requirements and also monitors and evaluates the performance of public and private agencies with regard to the execution and attainment of these policy and programme objectives (Agbodjah, 2008).

Table 2. Green Building Guidelines, Councils, Membership and Categories.

Description	BREEAM	LEED	Green Star	Green Star SA -GH
Parent Organization	Building Research Establishment Ltd.	U.S Green Building Council	Green Building Council of Australia	Ghana Green Building Council
Country	U.K.	U.S.	Australia	Ghana
Year of origin	1990	2000	2002	2011
Membership	420+	12000+	676+	-
Total no. of registered & certified projects	562300	33629+	1462	1
Type of Ratings	Pass 30–44% Good 45–54% Very Good 55–69% Excellent 70-84 % Outstanding 85+	Certified 40–49 Silver 50–59 Gold 60–75 Platinum 80+	1-3 star 10-44 4 star 45-59 5 star 60-74 6 star 75+	1-3 star 10-44 4 star 45-59 5 star 60-74 6 star 75+
Major Categories	Management Health & Well Being/indoor Envt Energy Water Materials Land Use, Site, & Ecology Emission & Pollution Innovation & Design (optional) Mobility & transport Waste	Sustainable Sites Water Efficiency Energy & Atmosphere Material & Resources Indoor Env'tal Quality Innovation & Design Regional priority	Management Health & Well Being/indoor Envt Energy Water Materials Land Use, Site, & Ecology Emission & Pollution Innovation & Design (optional) Mobility & transport	Management Health & Well Being/indoor Envt Energy Water Materials Land Use, Site, & Ecology Emission & Pollution Mobility & transport

Interestingly, Asamoah and Decardi-Nelson (2014) explains that, despite the existence of regulations that control the practices of stakeholders in the Ghana construction industry, it is still fraught with unprofessional practices, challenges relating to planning, lack of sustainability standards, cost overruns, project management challenges and so on. These all add to the already compounded challenge of corruption in land acquisition, building permit processing and consulting services provision.

1.4. Green Building origins and Status in Ghana

Ghana is notably one of the countries that easily adapt new trends and technologies to improve systems and aid development. Unfortunately, like many developing countries, Ghana has not fully embraced the green revolution in construction industry, and still has an industry largely practicing unsustainable traditional construction practices. This has led to shortages of materials on the market leading to price hikes for building materials, energy challenges and greater negative environmental impacts (Djokoto et al., 2014). Also, the adoption of GBCs and technologies in Ghana is noted to be slow and still in its infancy stage (Darko, Chan, Gyamfi, et al., 2017). The torch bearer of the GB revolution in Ghana, the Ghana Green Building Council was formed in 2009 and launched in 2011 as a member-based Non-Governmental Organization (NGO) which has its mission as "to transform the built environment in Ghana towards sustainability through the way our communities are planned, designed, constructed, operated and maintained" (GHGBC 2016). Operations of the NGO since its establishment has been largely limited to education and publication of the green building concept as a national framework that will create a combined enabling environment for the construction and execution of sustainable building construction undertakings. In terms of policy, currently there is no clear cut legislation, regulation, or government policy which makes it mandatory for GBCs implementation in building developments in Ghana despite numerous policies on housing and development. There has only been disjointed and piecemeal efforts in terms of policies which seek to promote aspects of the green building concept. From 1996, for example, renewable energy policies were formulated under the energy policy framework with the aim to develop indigenous and renewable energy sources from solar, small and medium sized hydro, wind, biomass and municipal solid waste (Energy Commission Ghana, 2006). Government of Ghana again in 2007, upon the advice of the Energy Commission of Ghana (ECG), embarked on a programme which saw them procure and distribute six million energy-efficient compact fluorescent lamps (CFLs) for free as a direct replacement of six million traditional incandescent lamps (ECG, 2009). This was however a one-off measure to mitigate the 2007 energy crisis in Ghana. To act as a coordinating panel, the government also established in 2009 the Sustainable Development Committee (SDC) with representatives from key MDAs and Civil Society (Ministry of Science and Technology, 2012). However, the activities of this committee are largely disjointed. Table 3 below summarizes a number of national frameworks aimed at ensuring sustainability and the built environment but without the existence of clear GB mandates in them.

Table 3. Summarized Government of Ghana Housing and related policies and Green Building Mandates contained therein.

Policy	Aim and Key Components	Implementation Status/GB Mandates
National Housing Policy and Action Plan (1987 – 1990)	Sets government's overall objectives and strategies towards affordable housing: Identifies affordable housing and slum upgrading, maintenance and infrastructure development	None
National Shelter Strategy, Vol. 1 & 2 (1993)	Advocates increase private sector participation in housing delivery, especially rental houses for low-income earners	None
Revised National Shelter Strategy, Part 1 & 2, 1999/2000		None
Ghana Poverty Reduction Strategy (GPRS I), 2003-2005	Slum upgrading including classification of slums based on deprivation extent Strengthening physical planning and planning scheme enforcement	Completed, impact limited due to few projects
Growth and Poverty Reduction Strategy (GPRS II), 2006-2009	Increase economic growth and poverty reduction to attain middle-income status: Affordable housing, slum upgrading/urban regeneration through urban infrastructure development, basic services provision, etc.	Completed, impact limited
Ghana Shared Growth and Development Agenda (GSGDA), 2010-2013	Affordable housing, slum upgrading/urban regeneration through urban infrastructure development, basic services provision, etc.	On-going implementation No clear GB mandates
National Policy on PPP, 2011	A framework to promote infrastructure development using Public-Private Partnership	On-going implementation with no clear mandate to ensure all such developments meet Green Building mandates

Continued on next page

Table 3 continued

National Urban Policy Framework, 2012	Comprehensive framework on urban development, including emphasizes on affordable housing and, prevention and upgrading of slum	Cabinet approved and on-going implementation
National Housing Policy, 2015	Review and merger of existing housing policy frameworks to make them more relevant and focused on the housing needs of low-income people. Concentrated on affordability and quantity.	Implementation on-going albeit no Green building mandates only a reference to Ghana Green Building Council's Framework for Green Community Development is made.
National Slum upgrading and Prevention strategy, 2013	Discusses issues of slum upgrading and prevention and livelihood improvement	On-going implementation without any mandatory Green Building requirements

Source: (Ghana Statistical Service, 2014) *Authors construct.

Despite this seemingly lack of policy direction, Ghana is one the developing countries which are making strides in promoting the uptake of green building. After the formation of the GhGBC in 2009, the pioneer green building in Ghana was completed in 2012 i.e. the One Airport Square as a pilot project for the adaptation of an international ”green” certification procedure in the Ghanaian context (Green Star SA). Designed by renowned sustainability architect Mario Cucinella, One airport square is a nine-storey 20 250m^2 building located in Airport City, in close proximity to Kotoka International Airport, Accra, Ghana. It stands upto four kilometers from Accra Mall (West Africa's first large-scale shopping centre). It is the first green commercial office building in West Africa. Key sustainability aspects of the one airport square include; solar building integration, vernacular building strategies, public spaces, renewable building materials, recycling and reuse, ecological building materials, integrated planning process, participation of users in planning process, low cost design, use of innovative design tools, natural cross ventilation, evaporative cooling, use of high thermal mass, energy recuperation etc. (sbd2050, 2018). See fig. 1 below for views of One Airport Square Building.

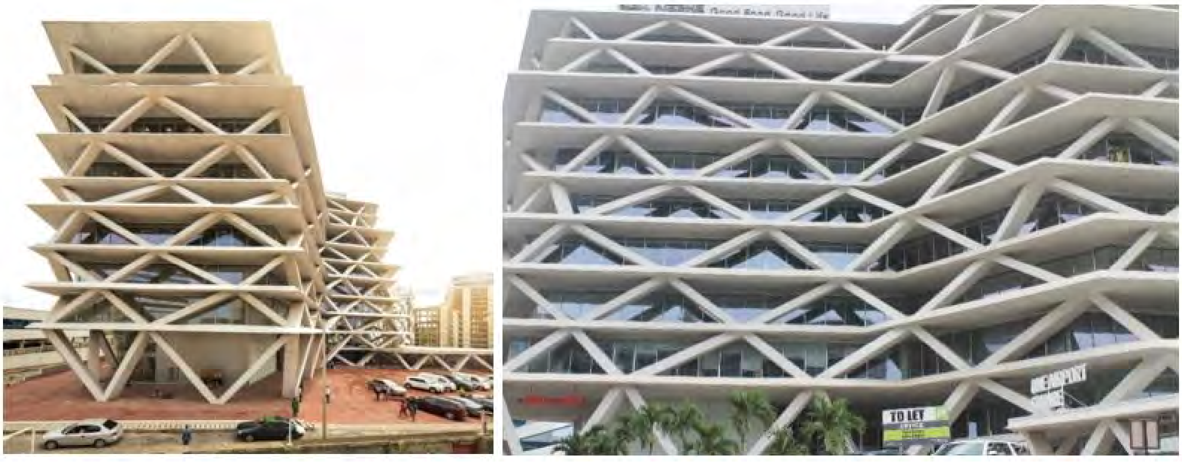

Figure 1. Views of the One Airport Square building (Source: sbd2050, 2018)

Further efforts in the journey led to the launch of the Eco-Communities National Framework which is “a vision, set of guided principles, and aspirations serving as the basis for the development of the rating system for communities, neighborhood, and cities development in Ghana”, in 2012 by Ghana Green building council (GhGBC, 2012). Also, in 2014, the Council moved a step further to practicalising the adoption of green building by adopting the La Bawalashie Presby school complex in Accra to rehabilitate and model it as a green school using the GB principles. This project is dragging for lack of funds.

Another remarkable milestone in the journey of the green building revolution in Ghana was the start in 2014 of Africa's first LEED for Health care- Silver category building; the New Ridge Hospital located in Accra, Ghana. The five-story, 465,560-square-foot hospital was designed by Perkins + Will in Miami as the architect, in collaboration with Bouygues Bâtiment International in Saint-Quentin-en-Yvelines in France as the general contractor was completed and commissioned in 2016. Key sustainability aspects of the Ridge hospital is described to include; long and stout layout of the building, with a large walkable ramp that connects the four stories of the hospital, cisterns installed underneath the building to collect and store water, natural ventilation for the facility, with naturally cooled breezeways, ventilated waiting areas, and outdoor rooms for large groups, solar hot water heater was installed to make the facility less dependent on electricity, plus the major part of the hospital is powered by solar energy, and there is an emergency generator in place to power the entire hospital when needed. See fig. 2 below for pics of the ridge hospital.

Figure 2. Views of the Ridge Hospital (Source:https://perkinswill.com/work/greater-accra-regional-hospital-ridge)

In the same year, 2016, two other projects; Radisson Blu Hotel - Exchange Complex and Exchange Complex Residential Blocks A & B both received Preliminary EDGE certifications. However, both projects are still under construction and yet to be completed and commissioned. In 2017 and early 2018 respectively, two other projects; and Consar Ltd New Head Office and GNPC Research and Technology Centre both in Accra also registered for LEED certifications and are awaiting certification. The latest certified green building in Ghana was commissioned in January, 2018. Located in the Komfo Anokye Teaching Hospital, Kumasi, is the new Mother and Baby Unit which received the EDGE hospital certificate to become the first EDGE certified 'green hospital' in Africa as well as the first certified green building in Kumasi away from Accra the national capital. The EDGE certificate confirms that the Mother and Baby Unit achieves 56% energy savings and 33% water savings when compared with a similar hospital. It also confirms that there is 42% less energy embodied in materials.

As observed above, some rating tools were used to measure the sustainability performance to enable certification hence they are considered effective instruments for leading the construction industry towards green building uptake. Currently, three of these rating tools have been used in Ghana. These include the US LEED, Green Star SA and EDGE. The GhGBC is still in the process of finalizing the adaption of the Green Star SA to a localized GB rating system for Ghana called Green Star SA-Gh.

Evident from the preceding trace as regards the development of green building of Ghana, its obvious that, its implementation is being driven by Private sector developers mostly in commercial office and retail buildings rather than government or Public bodies. The absence of GB specific regulations and authoritative GB rating tools which makes it compulsory for all governemnt projects to meet GB standards is largely to blame for this state of practice in Ghana (Djokoto et al., 2014). The following section shall explore what drives these efforts at green building and proposes measures by which the uptake of green building concepts and technologies in Ghana can be increased.

1.5. Drivers of Green building uptake

Literature is replete with a number of identifiable drivers of green building implementation in the built environment existing across different countries and regions. The key drivers of GB implementation include legislation and meeting other regulatory requirements, and incentives from national governments. Besides these, many stakeholders attempt to implement GB in response to a variety of needs and local conditions such as water and energy conservation or improvement of their marketability. In several instances these drivers have often been affected by National government policies and enactments. Drivers here refer to the decisions and actions which stimulate stakeholders to implement green practices including the potential benefits of GB practices. There are several drivers to GB uptake. In a survey of GB experts internationally, on the drivers of GB by (Darko, Chan, Owusu-Manu, et al., 2017), it was observed that, the key driver impelling the uptake of GB implementation is greater energy-efficiency. This was followed by reduced environmental impact, greater water-efficiency, enhanced occupants health, comfort and satisfaction, good company image/reputation and better indoor environmental quality. This finding is consistent with country specific studies on GB drivers such as that by (Ahn et al., 2013) which also identified energy-efficiency as the most important driver in the US and Manoliadis et al., (2006) in Greece who also identified energy conservation, waste reduction, indoor environmental quality and environmentally friendly energy technologies, resource conservation incentive programmes, performance-based standards, land use regulations and urban planning policies, education and training, re-engineering the design process, amongst others as top drivers influencing GB uptake. The picture is somewhat different when compared with developing country studies. For example, in a developing country such as Ghana, (Darko, Chan, Gyamfi, et al., 2017), expert opinions indicate that, setting a standard for future design and construction, greater energy efficiency, improved occupants' health and well-being, non-renewable resources conservation, and reduced whole lifecycle costs are the most important drivers of GB adoption. Other developing country context studies such as Zainul-Abidin (2010) in Malaysia, Serpell et al. (2013) in Chile and Windapo (2014) in South Africa have identified main drivers to include government regulations and policies, corporate image, client demand, cost reduction and company awareness among others. In India, (Arif et al., 2009) also reported the most significant drivers as government regulations, incentives, green image and high energy costs. See table 3 below for a list of green building drivers which are most discovered in the survey.

Table 4. Green Building Drivers

Drivers of Green Building uptake	
Preservation of natural resources and nonrenewable energy sources	Increased energy efficiency of buildings
Reduced lifecycle costs of building structure	Increased water efficiency of buildings
Enhance occupants' health and comfort and satisfaction	Reduced environmental impacts of buildings
Good company image/reputation or marketing strategy	Better indoor environmental quality
Improve the performance of national economy and create jobs	Thermal comfort
Better rental income and increased lettable space	Attract premium clients and enhanced property value
Better workplace environment	Reduce construction and demolishing wastes
Set standards for future design and construction	Reduced use of construction materials
Efficiency in construction processes and management practices	Facilitate a culture of best practice sharing
Attract quality employees and reduce employee turnover	Increase overall productivity

Continued on next page

Table 4 continued

Satisfaction from doing the right thing	

Vanegas and Pearce (2000), Manoliadis et al. (2006), Wilson & Tagaza (2006), Bond (2011), Häkkinen & Belloni (2011), Zhang et al. (2011), Arif et al. (2012), Liu et al. (2012), Love et al. (2012), Ahn et al. (2013), Gou et al. (2013), Li et al. (2013), Serpell et al. (2013), Abidin and Powmya (2014), Liu et al. (2014), Low et al. (2014), Mulligan et al. (2014), Windapo (2014), Zhai et al. (2014), Zhang (2014), Aktas & Ozorhon (2015), Simpeh & Smallwood, (2015), Windapo & Goulding (2015), Chan et al. (2017), Darko, Chan, Owusu-Manu, et al. (2017), Darko et al. (2017), Darko & Chan (2018).

1.6. Implications of Green Building driving forces on uptake of Green building in Ghana.

The implications of these drivers for a developing country such Ghana are far-reaching and deserving of attention. For Ghana as a developing country which has been plagued with chronic and recurring energy crisis and 'dumsor' (unstable power supply) has persisted from 2013 till early 2017, the importance of these drivers of GB uptake cannot be overemphasized. The statistics from the ECG (2015) indicate the reseidential sector is the highest consumer of energy than any other economic sector having consumed 43% of the country's total energy between 2005 to 2014. As such, greater energy-efficiency of buildings and the built environment as a driver of GB uptake would significantly contribute to solving the energy situation in the country. To achieve this, encouraging the use of energy-efficient technologies such as smart metering, energy-efficient windows and light emitting diodes (LED) bulbs as well as using renewable energy systems such as solar panels is advised. For example, a building uses only 10% of the energy used by incandescent lamps for reaching the same level of illumination when solid-state lighting technology is applied. This even lasts 10 times longer (Yang and Yu, 2015). Additionally, 20–50% savings of energy costs can be achieved by using energy saving technologies, natural daylight and ventilation, renewable energy technologies, and light-reflective materials (USGBC, 2003), implying that utility bills as well as money is saved over a GB's lifecycle by stakeholders. Moreover, this would great impact Ghana's efforts at meeting the Sustainable developments goals specifically Goal 7 – affordable and clean energy- ensure access to affordable, reliable sustainable and modern energy for all. To this end, Owusu-Koranteng (2015) argues that it is about time the incorporation of green technologies and practices into architectural designs, and solutions to the energy efficiency and sustainability challenges in Ghana is targeted at the housing construction industry.

Water efficiency as a driver of GB uptake is equally very relevant to a developing country as Ghana. Successive governments in Ghana have battled recurring water crisis severally. In the latter parts of 2007 leading to February, 2008, there was a severe water shortage in Ghana and the popular 'Kufuor gallons' became synonymous with water scarcity and people had to carry these gallons and trek long distances in search of water, particularly, in Accra. Again, in January, 2018, the Ghana water company limited announced a water rationing time table as a result of inadequate supply due to the dry season (Nathan Gadugah, 2018). The solution to this perennial problem of water shortages lies in the bosom of GB uptake. It is therefore essential that the water use in buildings is reduced and the application of GBs can easily and efficiently achieve this. For instance, the application of suitable GBTs, such as rainwater harvesting, water reuse, greywater recycling, permeable surface technology and on-site sewage treatment, are noted to improve the water efficiency of buildings. Ghana has made several efforts to harmonize issues of water supply and usage. The national water policy 2007, was launch in 2008 with the intention to provide a framework for the sustainable development of Ghana's water resources (Ministry of Water Resources, 2007). The only green building technology contained therein is rainwater harvesting, even that, the implementation has not happened as the document is gathering dust on the shelves. Achieving water efficiency in buildings can bring about an added value that will benefit the end-user since low water usage will result in lower water bills and subsequently make up for the higher initial costs over the life time of the building. This can motivate stakeholders to implement green building practices in Ghana if harmonized.

Another factor driving the uptake of green building is environmental/non-renewable resources conservation. The conservation of non-renewable resources is important for green building implementation because, non-renewable resources are crucial in sustaining human activities, for a smart and sustainable development in a country such as Ghana whose non-renewable resources are scarce. There is therefore the need to protect and conserve these resources. Ghana's construction industry is notable for a lot of adverse environmental infractions including sand wining and the cutting of timber for construction purposes. Also construction activity is noted to generate a lot of CO2 emissions which pollute the environment. By using GB technologies instead of non-renewable energy sources, GHG emissions as well as air pollution is significantly reduced. Such GB technologies as Wind and Solar energy are worthy options to non-renewable energy sources (Love et al., 2012).

Government policy and regulations is one green building uptake driver which seem to be consistent in most developing countries. In Ghana as evidenced in the policy narrative in section 1.5 above, there is no clear government policy framework mandating the uptake of GB. This is as opposed to the developed countries like Australia, U.K, and U.S, where there are legislations mandating GB uptake hence developers naturally comply. For instance, as earlier mentioned, EPBD was an EU directive which ensured all buildings met an energy criteria (EPBD, 2009). As such, developers had to necessarily comply. Governments role in stimulating GB implementation is both critical and undeniable as noted by Samari et al., (2013) as cited in Djokoto et al. (2014). There are a variety of instruments available to governments for use in facilitating the progression in green building uptake.The EPA is Ghana governments agency mandated with the responsibility of ensuring sustainability of the environment. However, the agency is hardly able to enforce the rules and regulations particularly those with a bearing on green building. Its is both vital and critical at this stage of Ghana's development to have a government which is ready to lead in the provision of green buildings.

There are several other drivers (see table 3 above) influencing the uptake of green building which require the attention of stakeholders in Ghana construction industry to enable the realisation of the benefits of sustainability such as development of highly water and energy efficient buildings with less negative impacts on the environment.

1.7. Measures to stimulate the adoption of Green building implementation in Ghana

Globally, there is a sharp rise in interest for GBCs in the construction industry because of their numerous benefits. The uptake is however noted to be slow in a developing country as Ghana as earlier referenced. It is therefore necessary to seek measures aimed at fast propulsion of the widespread uptake of GBCs in the Ghana construction industry.

To start with, there is the need to create awareness among stakeholders of the numerous benefits that drive the adoption of green building. A national education, awareness and publicity campaign can serve to conscientise the public drawing their attention to their roles in implementing GB technologies and practices. The explosion and plurality of local radio stations and television stations as well as the vibrant media landscape in the country should be an advantageous spring board for stakeholders to inform the populace about GB. Such education must not be limited to large scale benefits of GB but also on the benefits of small scale self-to-do GB technologies such as rainwater harvesting, use of permeable pavements, natural ventilation etc. So as to bring up a future generation of green-oriented Ghanaians, public education on the benefits of GB suggestively should start at the basic level through to the tertiary level. Publicity through the electronic media of the internet and television is noted to take advantage of innovative technologies to easily reach and communicate with the public about GBTs (Thackeray et. al. 2007). The efforts of the GHGBC which has been organizing workshops and seminars in a bid to educate stakeholders on green building needs to be complemented and up scaled.

In order to promote the uptake of GB, one key strategy is the imposition of mandatory government policies and regulations on GB development on stakeholders in the built environment. Existing building regulations in Ghana don't account for green features and enforcement of building codes in the construction climate of Ghana has not been effective. Therefore the imposition of such regulations on stakeholders would force and exert pressure on them to adopt necessary steps for GBC uptake so as to avoid being fined. These government policies would eventually serve as incentives to stakeholders to incorporate GB technologies in their projects. Potbhare (2009) notes that, government policy may validate the effectiveness of these GB practices to the society. Such policies as modifying the procurement and bidding process to require green features, including green practices in lease contracts, giving green projects priority permits etc. are proposed. It is also proposed that, the government of Ghana leads by example making sure all government projects are built to green standards while existing ones are retrofitted to green standards. For instance, the parliament of Ghana is in the process of procuring for a new parliamentary chamber to be built, if they take the lead to ensure that, it is built to green standards and duly certified, it would be a good example and reference point particularly that, they are the law makers for the country. The government of Ghana being the single largest client of the industry can also institute a bye-law requiring all its numerous school, hospital and other projects to incorporate green features; the built environment would witness a massive revolution.

Closely related to the imposition of mandatory regulations is the provision of financial and market-based incentives to catalyze the uptake of GB. The implementation of GB technologies are noted to have higher initial costs than the conventional buildings (Kats et al. 2003), and it would be a motivation to the stakeholders if the government introduce incentives such as tax exemptions, rebates and discounts. The government can rally financial institutions and green NGOs to this endeavor. These incentive schemes compel people to adopt GBTs, as they are normally awarded only when certain green requirements have been fulfilled and the Ghana real estate developers association (GREDA) - a key stakeholder in the industry has always advocated for it. Its is yielding positive results for Governments in developed countries such as the US, Hong Kong, and Singapore who have adopted it and the Ghana government can learn from them.

Other ways of influencing the adoption of GB in the view of this paper include; ensuring that the GHGBC standardizes the Green Star SA-GH to suit local conditions and fully role it out for practitioners to use, training and educating stakeholders and practitioners in particular on the rating tools, developing a robust research and development department to do a country specific database on green building; these would enormously propel the uptake of green building practices and technologies in Ghana as well as enable the realisation of such sustaianability benefits as realising highly water and energy efficient buildings with less adverse effects on the environment by stakeholders.

1.8. Conclusion

In conclusion, existing literature reveals a gap in green building studies pertaining to less developed countries especially in Ghana. The research reviews numerous benefits of green building as far as the built environment is concerned. The review paper endeavored to trace the origins and development of GB to its current status in the Ghana construction industry. It reveals that, GB is still at an infant stage in Ghana with only four (4) certified green buildings and two (2) others registered and awaiting assessment for certification. It also reveals that, private developers are taking the lead to initiate green building projects with very little government involvement in Ghana. Again the drivers inducing the uptake of GB in the Ghana construction industry are reviewed to enable stakeholders identify and place emphasis on the key ones. This paper concludes by proposing ways and means by which stakeholders can promote the fast, successful and widespread uptake of the green building concepts and technologies in the Ghana construction industry. Implementing green building concepts and technologies would enable the achievement of goals 3, 7, 8, 9, 11, 12, 13, 15, and 17 of the SDGs in developing countries especially Ghana. As a result of the theoretical nature of this paper, it adds to the collection of knowledge in relation to green building in developing countries. It would also improve the understanding of key stakeholders in developing countries and guide them in the design and implementation of applicable measures for GB adoption promotion as well as serve as a teaser for further research to focus on empirical assessments of GB as well as its measureable contributions in developing countries so as to help increase the uptake of GB in developing countries such as Ghana.

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