Master's Degree Thesis

The Construction Industry in Ghana, West Africa

"How can the construction industry in Ghana become sustainable?"

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Abstract: The Sub-Saharan African country of Ghana is growing at a rapid pace. The construction industry is striving to keep up with the increasing demand for housing and commercial and industrial space while simultaneously protecting the physical environment and social well-being of the country – a challenge becoming known in the industry as 'sustainable construction.' This paper proposes a strategic approach to manage these twin challenges, consisting of two parts: a building rating system and a participatory method called multi-stakeholder dialogue. The combination rating system and MSD process was presented to the industry to determine its potential effectiveness in assisting the industry to move towards sustainability. The industry's response indicates that the proposal could be of value to the industry, with certain noted limitations. This paper describes the rating system-MSD proposal, the industry's response, and implications for the construction industry in Ghana moving forward

Keywords: Ghana, Construction, Sustainability, Sustainable construction, Green Building-Rating tool, Template for Sustainable Product Development, multi-stakeholder dialogue.

Statement of Contribution

The process of crafting this thesis has been a truly collaborative effort largely driven by an interest to focus on a practical issue and a desire to thoroughly research the sustainability challenge in a sub-Saharan African country.

Kwaku Ahmed exhibited extensive knowledge about Ghana – its history, politics, and culture. Kwaku arranged the interviews and made all further arrangements for our trip to Ghana related to the research for this thesis. His experience in writing academic papers was invaluable as was his research and contribution to each of the literature review, methods and analysis of results.

Lamia Hatira contributed her extensive knowledge of stakeholder investment, communications, and sub-Saharan Africa. She wrote the section on multi-stakeholder dialogue, was responsible for much of the editing of the paper, and created the apt and vivid slides for the presentation. Lamia's imaginative sense of humor kept us laughing and buoyed our spirits throughout the process.

Paul Valva's extensive knowledge about the construction industry and building rating tools was essential to our research and a driver in focusing our research and matching it to the program's requirements. Paul wrote about the Green Star Building Rating Tool as informed by the TSPD and was also our referencing and formatting guru. Most importantly, Paul looks very good in a handmade leopard shirt from Ghana.

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Executive Summary

Introduction

Rapid population growth, urbanization and an economic boom in the Sub-Saharan African country of Ghana are creating an increasing demand for renovated and new residential and commercial buildings. Throughout the entire country, and especially in the densely populated urban areas, construction is developing at a rapid pace to meet the rising demand. The design, construction and operation of the buildings are putting increasing stress on the energy, water and sanitation systems, the materials used in the construction process, the landfills used as a repository for the waste generated by the building and demolition activities, and on the land itself. The social systems are also under stress, in the form of increased traffic and congestion, failing infrastructure, and growing economic disparity between the wealthiest and least wealthy segments of the population. The pressures put on the ecological and social systems are simply unsustainable if continued at their current rate.

The construction industry (the "industry") in Ghana is aware of the many challenges facing the country and the industry in particular. The industry, in collaboration with government, academia and the public sector, is working towards a process that will both meet their own business interests while simultaneously protecting the environment. The issue is less one of awareness of the challenges than of formulating a strategy to move towards sustainability in the industry. The challenges are complex, involving a multitude of causes, impacts and diverse stakeholders, all with their own vision of what 'successful' development can and should look like. In short, the industry is searching for a vision of a sustainable future, and a process to arrive there.

In the context of the construction industry in Ghana, the sustainability challenge consists of making decisions and undertaking actions today that can meet the demand for commercial and residential construction without compromising the needs and well-being of future residents – or of the ecological state of the country itself. A strategic process to address the sustainability challenge includes having a clear understanding of the causes and impacts of the problems, formulating a clear objective to be pursued, developing a strategy to move towards the objective, and assessing the progress towards the process. This paper discusses a methodology to assist the industry in developing and assessing a process to move towards sustainability in the construction industry.

A strategy towards sustainable construction is considered from two perspectives: first, from the perspective of an individual contractor making decisions everyday during a construction project; and second, from the perspective of society itself, as represented by diverse stakeholders impacted by the development process. Both perspectives are relevant and important to a successful strategy towards sustainability. Two proposals, separate but inter-related, are discussed. The first, particularly relevant to the individual contractor, considers whether the Green Star Building Rating System currently being used in Ghana is robust enough to meet the sustainability challenge. A processing tool called the Template for Sustainable Product Development is proposed as a method to improve the G.S. Rating System's ability to move the industry towards sustainability.

The second proposal discusses how multi-stakeholder dialogue (MSD) could be a method the diverse set of stakeholders could use in the planning process. The relationship between the G.S. Tool and MSD is also presented.

In summary the Research Questions proposed by this paper are:

Are stakeholders of the construction industry in Ghana open and receptive to making their industry sustainable?

Could sustainability oriented tools and processes help facilitate the transition towards the adoption of sustainable practices within the construction industry?

Literature Review

A literature review was undertaken with two purposes in mind: to understand the current state of the construction industry in Ghana; and to aide in developing a proposal analyzing the building rating system being developed in Ghana, and understanding the role of multi-stakeholder dialogue in the planning process.

The literature review resulted in a clearer understanding of the intent and structure of the Green Star Building Rating System (aka the G.S. Tool), and a concept of how the TSPD could improve the G.S. Tool. Further review of the literature provided insight as to the value of MSD in applying the TSPD to the G.S. Tool, using the informed Tool to move towards sustainability, and in aiding the planning process in general.

Methods

The literature review resulted in a strategy, which could then be presented to the construction industry for their response. A model of the G.S. Tool was presented to the industry, together with a proposal of how MSD could help implement the model and then use the informed Tool in a strategic process. The industry's response was reported and discussed in the Results and Discussion sections, respectively.

Results

In general the industry was favorable to the concept of improving the G.S. Tool, and using MSD as a method in doing so. The industry commented on the benefits of improving the Tool, how the process could work, and some limitations to the proposal presented in this paper. Their comments were then incorporated in the design of the proposal with the expectation that the Tool, as informed by the TSPD, vetted by the industry, and implemented by an MSD process, could be a useful process to enable the industry to move towards sustainability.

Discussion

Together with the industry's response to the proposal, the discussion focuses on a process of how the proposal could best be implemented in the context of the Ghanaian construction industry today, given the political, economic and social milieu of the country in which the industry is operating. Consideration was specifically given to the technical details of applying the TSPD to the G.S. Tool, and the practicality of using MSD in the local Ghanaian context.

Conclusion

Construction of buildings is a major contributor to the sustainability challenge on both a global level and in Ghana. The topic is relevant and important to the economic, ecological and social well-being of Ghana and to the entire planet. If the proposal presented in this paper were to be implemented by the construction industry in Ghana, it could provide a strategic set of guidelines by which the industry could move towards sustainability. Further research will need to be done to determine if i) the construction industry in Ghana does indeed implement the proposal in their planning process, and ii) to determine if the proposal does move the industry towards more sustainable development. Research could also be undertaken to consider how the proposal could be expanded and applied on a wider scale.

Glossary

Australia Green Building Council: The Green Building Council in Australia.

Building rating systems: A type of sustainability assessment indicator used to evaluate the performance of a building. Also known as 'building rating tools and building assessment indicators.' In terms of sustainability, used to determine the level of sustainability of a building.

Buildings: All buildings in the built environment, including residential, commercial and civic, such as schools, hospitals and entertainment facilities.

Built environment: The part of the physical environment that is constructed by human activity (Saelens and Handy 2010). For the purposes of this paper, the built environment includes only buildings and excludes infrastructure such as road, bridges, parks, utility systems and sanitation systems.

Commissioning Agents: Individuals trained and licensed to guide contractors through the Green Star application process.

Construction industry (aka the 'Industry'): Individuals and organizations directly involved in the design, construction and operation of buildings. Includes architects, land and building owners, developers and contractors.

Five Level Framework: A conceptual tool used for analysis and decision-making when planning in complex systems. It consists of five distinct levels: System, Success, Strategic, Actions, and Tools (Robèrt et al 2010, 26).

Framework for Strategic Sustainable Development (FSSD): A five-level framework that addresses society's systematically increasing impacts on the limited resources of the biosphere and social systems to offer organizations a strategic framework for planning and decision-making by using backcasting from sustainability principles to prioritize actions that move towards a sustainable future (Robèrt 2010, 34).

Ghana: A country in Sub-Saharan Africa. For the purposes of this paper, includes the entire country of Ghana.

Ghana Green Building Council: The Green Building Council in Ghana.

Green Building Council: Member-based organizations that partner with the construction industry and government in the transformation of their building industries towards sustainability. (Ghana Green Building Council 2011, 71).

Green Star Building Rating System (aka Green Star Building Rating Tool – G.S. v1 Building Rating System): The building rating system used by the Australia Green Building Council.

Green Star Building Rating System-Ghana (G.S. GH-v1 Building Rating System): The building rating system being developed in Ghana.

Green Star Building Rating System-South Africa (G.S. SA-v1 Building Rating System): The building rating system used in South Africa.

Green Star Building Rating System-South Africa-Ghana (G.S. SA-GH-v1 Building Rating System): The building rating system being used on an interim basis in Ghana.

Green Building Council - Ghana Technical Team: A group of highly trained individuals developing the Green Star-Ghana Building Rating System.

Human needs: The nine basic human needs as defined by Manfred Max-Neef: identity, freedom, protection, idleness, understanding, subsistence, affection, creativity and participation (Max-Neef 1991).

Matrix: The G.S. Building Rating System as informed by the Template For Sustainable Product Development.

MSLS: Master's in Strategic Leadership towards Sustainability Program offered at Blekinge Tekniska Högskola (BTH).

Multi-Stakeholder Dialogue: A process of dialogue and ultimately consensus-building of all stakeholders as partners who together define the problems, design possible solutions, collaborate to implement them, and monitor and evaluate the outcome (Hemmati et al, 2001, 40).

South Africa Green Building Council: The Green Building Council in South Africa.

Stakeholders: Any individual or group who can affect or is affected by the achievement of the organization's objectives (Feige et al 2011, 506).

Strategic sustainable development (SSD): A framework for systematically planning towards compliance with basic principles for sustainability (Robèrt 2002, 242).

Sustainability: Practices that do not systematically degrade the socio-ecological system of the planet (Robèrt et al. 2010, 14). For purposes of this paper, construction practices that protect the physical environment and social well-being of the local community.

Sustainability assessment indicators: Used to provide summaries and to focus and condense the complex surroundings into a form of manageable indicators (Suopajarvi 2011, 8).

Sustainability challenge: Challenges associated with unsustainable development that have continued to increase, systematically degrading the natural biosphere and the social systems, within which human society depends (Robèrt 2002, 245). It also includes the obstacles to overcoming those challenges and the opportunities for society if those obstacles are overcome (Robèrt et al. 2010, 267).

Sustainable: Practices that "meet the needs of the present without compromising the ability of future generations to meet their own needs" (United Nations 1987).

Sustainable building: A building that is designed, constructed and operated within the principles and guidelines of sustainable construction.

Sustainable construction: Construction that meets the demand for housing and commercial and industrial space while simultaneously protecting the physical environment and social well-being of the country.

Sustainable development: A strategic mission to eliminate society's unsustainable, systematic errors and create a sustainable society, thereby stabilizing the resources available to support civilization (Robèrt et al 2010, 14). For the purposes of this paper, the equivalent of sustainable construction.

Tools: The tools that support efforts to plan and build sustainable buildings.

Template for Sustainable Product Development: Tools that can provide a quick, early overview of the sustainability performance of a general product type (Robèrt et al 2010, 231).

Unsustainable construction: Design, construction and operation of buildings that do not protect the environment or the social well-being of the local community.

World Green Building Council: The collective voice of more than 85 Green Building Councils around the world (Ghana Green Building Council 2011, 73).

List of Acronyms and Abbreviations

5LF: Five Level Framework
FSSD: Framework for Strategic Sustainable Development
GBC: Green Building Council.
GBCA: Green Building Council Australia
GBCSA: Green Building Council South Africa
GHGBC: Ghana Green Building Council
G.S.: Green Star
G.S. v1 Building Rating System: Green Star volume 1 Building Rating System
G.S. GH v1 Building Rating System: Green Star Ghana volume 1 Building Rating System
G.S. SA v1 Building Rating System: Green Star South Africa volume 1 Building Rating System
G.S. SA-GH v1 Building Rating System: Green Star South Africa-Ghana volume 1 Building Rating System
MSD: Multi-Stakeholder Dialogue
MSLS: Masters in Strategic Leadership Towards Sustainability
SSD: Strategic Sustainable Development
TSPD: Template For Sustainable Product Development
WBC: World Business Council

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1 Introduction

The combination of rapid population growth, urbanization and economic development are putting the African continent at risk with regards to meeting the increasing demands for housing and urban planning (De Boeck 2013, 3). Although the construction industry could form the bedrock for possible solutions to the developmental challenges (Ebohon and Rwelamila 2001, 1), accounting for more than 60% of the gross national capital in Ghana (Laryea 2010, 1), their significant contributions to sustainability challenges in society and the biosphere as a whole have been little emphasized in Africa (Adebayo 2002, 1). The need to develop appropriate strategies and actions to make the construction activities in the region more sustainable is of great importance to society (Djokoto et al. 2014, 135).

Against a backdrop of population growth, migration and urbanization, Ghana faces many development challenges, including sporadic economic growth (Chikweche and Fletcher 2014, 1), environmental degradation, and overwhelming and complex social issues. Though economic growth has historically lagged the rest of the world, the continent has averaged 4.5% growth in GDP per year since 2000 (Oxford Economics 2012, 3). Oxford Economics forecasts that between now and 2030, GDP growth will exceed every other region of the world (Oxford Economics 2012, 3). There is a close relationship between economic growth and the construction industry, characterized by the physical infrastructure and asset-based-development upon which growth and development are achieved (Songwe 2014, 18).

The sustainability aspects in the built environment are generally concentrated on reducing the environmental footprint of buildings. Sustainable buildings are assessed by: (1) reduced production of greenhouse gas emissions (particularly carbon dioxide); (2) reduced use of natural resources, in particular, water, gas and electricity; (3) reduced waste production and increased recycling; (4) enhanced building occupant health, comfort, and safety; (5) production of renewable resources; (6) collection of water for potable and non-potable uses; and (7) recycling and treatment of sewage and waste water. Furthermore, sustainable construction can be qualified as a special case of sustainable development targeting the construction industry especially, whose role it is to develop, plan design, build, alter or maintain the built environment, including the building materials manufacturers and suppliers (Adebayo 2002, 2).

A new approach to sustainable building evolves from the incorporation of the concept ‘sustainable development’ into the real estate and construction industry that provides an integrated approach to environmental, social, and economic dimensions. The World Commission on Environment and Development (WCED) popularized this concept in the Brundtland Report in 1987, indicating that it “meets the needs of the present without compromising the ability of future generations to meet their own needs” (United Nations 1987).

At a broad level, successful strategic sustainable development for the construction industry can be summarized as “energy efficient and comfortable living and working spaces, with 70% of the world’s population living in urban areas, 95% of existing building stock using zero net energy, and less than 5% of buildings heated with fossil fuels” (World Business Council for Sustainable Development Vision 2050 Project n.d.). This vision is in alignment with one set by the Ghana Green Building Council (GHGBC), which represents the sustainable construction industry in Ghana. GHGBC’s Mission Statement is “to transform the built environment in Ghana towards sustainability through the way our communities are planned, designed, constructed, maintained and operated.” Their vision statement follows

with “to significantly improve the overall health and lives of present and future generations through sustainable buildings and communities” (GBC Official Launch Handbook 2011, 11). The mission statement of the architectural community is “To provide innovative and high quality services in the design and supervision of projects in an efficient, timely and cost-effective manner to the satisfaction of our clients, using a highly motivated and dedicated workforce” (Atongo 2014).

Nevertheless, there exist myriad challenges facing the construction industry in Ghana today. Increasingly, insurmountable social, environmental, health and economic challenges continue to hinder the growth of Ghana's construction industry. An inconsistent electrical grid, overburdened public water distribution system, poor public sanitation, overcrowded living conditions and failing infrastructure make both the industry's future success and present state difficult to sustain. If not addressed soon, further ‘upstream’ problems, such as dependence on fossil fuels, overburdened hydroelectric power for energy, rapid deforestation of timber, toxification of ground water, and unregulated ‘horizontal’ growth resulting in urban sprawl will have long term detrimental impacts on Ghana’s future.

Energy inconsistency has stalled the completion of many construction projects in Ghana. The country depends on hydroelectric power energy for 59.40% of its electricity production (CIA Fact Book n.d.). As such, recent droughts have created water shortages, resulting in sporadic electricity fluctuation throughout the country, affecting the timely completion of construction projects.

Additionally, the construction industry in Ghana performs poorly in minimizing their environmental impact. Construction activities are linked to excessive resource consumption causing land degradation, loss of habitats, air and water pollution and high-energy usage (Ofori 2012, 7; Djokoto et al. 2014, 135).

A typical Ghanaian building often depends largely on timber and other forest products. In traditional building construction, wood from timber is used to make the formwork and scaffolding. A major limitation with this approach is the inability to either recycle or reuse after initial use. This has caused dependency on natural resources, depleting major evergreen rain forests in the country. As a result, certain species of wood such as ‘*Wawa,’* which were in abundance in the 1970’s, are now difficult to find. These building procedures have taken a significant toll on the environment (Amoako 2014).

Another set of challenges that play a significant role in contributing to the country’s toll on the environment include rapid population rise and urbanization that are resulting in unsanitary living conditions, a shortage of housing units, and steep housing prices. Ghana has seen its population rise by 565,000 people per year since 2008. Of the new residents in Ghana, 40% are under the age of 14 (Imaralu 2013). Kumasi, Ghana’s largest city, is the fifth fastest growing city in Africa with population growth at 5.40% per year (Zawya 2012). This rapid increase in urban population has resulted in a current deficit of 1.7 million housing units (Atongo 2014). At the current rate of urbanization, the United Nations Human Settlement Program estimates that Ghana will need two million new housing units by 2020 to meet the demand for housing (Imaralu 2013). With the current population density already exerting stress on resources and services, meeting the increasing demand will further exacerbate the sustainability challenge.

Among the tools industry practitioners use to design and assess building performance are building rating tools. Building rating tools assist architects and contractors who are concerned about sustainability in the design and construction of buildings, similarly to what blue prints do for traditional buildings. In the construction of a traditional building, the

clearer the blue print is, the closer the building will mirror the desired result. Similarly, in the construction of a sustainable building, the clearer the building-rating tool is, the more sustainable the building will be. The question then becomes "How can the building rating tool be as clear and precise as possible?"

The technical team of the GHGBC is currently developing a building rating system for Ghana called the GS GH-v1 Tool (herein referred to as the Tool). The intent of the Tool is to guide the construction industry in Ghana towards sustainable construction. Because the development of the Tool is in an early phase of development, there is an opportunity to contribute to the design of the Tool that will make the Tool as clear and robust as possible. The Template for Sustainable Product Development (TSPD) is a framework that may assist the GHGBC in the development process. This paper will discuss how the TSPD can be used to contribute to the development of the GS GH-v1 Tool. It will further discuss how the industry stakeholders can engage in a participatory method known as multi-stakeholder dialogue (MSD) to jointly discuss the Tool's varying elements as they pertain to the Ghanaian context and determine what their roles are in the development of the industry towards sustainability.

"Sustainable development requires a process of dialogue and ultimately consensus-building of all stakeholders as partners who together define the problems, design possible solutions, collaborate to implement them, and monitor and evaluate the outcome. Through such activities, stakeholders can build relationships and knowledge which will enable them to develop sustainable solutions to new challenges" (Hemmati et al, 2001, 40). The objective of a participatory process like multi-stakeholder dialogues is to understand stakeholders' attitudes towards sustainable construction and gauge their views on the green building-rating tools as a method to move towards sustainable construction in Ghana.

Research Questions, Objective of the Paper and Scope of Research

The Research questions addressed in this paper are:

Research Question 1: "Are stakeholders of the construction industry in Ghana open and receptive to making their industry sustainable?"

Research Question 2: "Could sustainability oriented tools and processes help facilitate the transition towards the adoption of sustainable practices within the construction industry?"

Objective of Paper:

The objective of this paper is to develop the case for a strategic methodology by which the construction industry in Ghana can move from its current state of performing unsustainable practices towards greater sustainability.

Scope of Research:

The paper will limit its scope to the construction industry in Ghana and in particular to the construction of buildings and not to the greater built environment of roads, bridges, utilities, and sanitation systems. 'Buildings' includes all types of structures, including housing (single family residences and multi-unit); commercial buildings (offices and retail buildings); industrial (warehouses, distribution centers, manufacturing plants); and civic structures (auditoriums, schools, hospitals and government buildings).

2 Literature Review

The comprehensive literature review afforded an understanding of the current level of sustainability in the Ghanaian construction industry, the efforts being made to move towards sustainability, and the existing gaps that would allow for further development.

The literature review consisted of three phases – the first to examine the current state of the construction industry in Ghana; the second to examine any building rating systems that the industry may be using to guide contractors in their daily construction practices; and the third to analyze any processes that the industry is using or could use as a whole to become sustainable. Both academic and practitioner-oriented literature were examined.

2.1 Ghana & Ghana's Construction Industry

Ghana is a West African country bordered by Côte d'Ivoire to the west, Burkina Faso to the north, Togo to the east, and the Atlantic Ocean to the south. In 1957 Ghana became the first sub-Saharan country in colonial Africa to gain its independence. In late 2010 Ghana was categorized as a lower middle-income country and now envisions becoming the first developed country in Africa between 2020 and 2029 (Rawlings 1995).

The country has a tropical climate and commonly endures droughts due to its dry weather. Deforestation, soil erosion, habitat destruction, water pollution and inadequate supplies of potable water are further ecological problems that affect Ghana's environment (CIA Factbook 2014).

Ghana in Numbers

Ghana Population	25,758,108 (2014 est.)
Accra Population	1,658,937 (2012 est.)
Urban population	51.9% (2011 est.)
Total area	238,533 sq. km
GDP (growth rate)	7.9% (2013 est.)

(Oxford Business Group 2014; CIA Factbook 2014)

Ghana is renowned as an emerging market in sub-Saharan Africa, thanks in large part to contributions from the building construction industry (Laryea 2010, 1). This industry is dominated by physical infrastructure and asset-based-lending as a means for growth and development (Songwe 2014, 18). According to Asamoah and Decardi-Nelson (2014, 63), the construction industry contributes about 5% to 10% of Gross Domestic Product (GDP) to the country and employs nearly 10% of the working population. Ofori (2012, 5) has identified the sporadic development of the construction industry in local areas as a means of alleviating poverty in the country.

The Ghanaian construction industry is complex in nature, representing a range of stakeholders (Dadzie et al. 2012, 256). The Ministry of Water Resources, Works and Housing, responsible for the housing infrastructure and construction throughout the country, classifies building contractors into four groupings: projects worth up to $75,000 (D4K4); projects ranging from $75,000-250,000 (D3K4); projects worth $250,000-500,000 (D2K2); and projects over $500,000 (D1K1) (Frimpong and Kwasi 2013, 121). The majority of the companies in Ghana fall under D4K4 and D3K4 classification (Oxford Business Group 2014). The Chartered Institute of Building in Ghana estimates that there are over 1,600 building contractors working in Ghana since October 2012 (Oxford Business Group 2014).

Although the building construction industry supports the country's economy and thus provides a means for social development, the industry is characterized by unprofessional practices (Asamoah and Decardi-Nelson 2014, 63). The industry suffers from a lack of planning, including inappropriate water and energy use, building material consumption, failure to meet consumer/tenant needs, and disjointed stakeholders cooperation in the industry (Twumasi-Ampofo et al. 2013, 6). These deficits form part of an industry mired in corruption without transparent processes for procuring the services of consultants and contractors (Asamoah and Decardi-Nelson 2014, 63). The unsustainable building construction processes coupled with the constant degradation of the environment continue to take their toll on Ghana's development (Djokoto et al. 2014, 135).

The problem-ridden industry must also deal with a national housing problem in need of 70,000 units annually and an accumulated delivery deficit of 250,000 units to meet the housing demands (Twamasi-Amofo et al. 2014, 6). These numbers are backed up by the U.N. Human Settlement Program who estimate that Ghana will need two million new housing units by 2020 to meet the demand for housing (Ilamura 2013). The sustainability challenge confronting the construction industry is to meet the demand for housing and other buildings in a strategic and sustainable manner.

Normally stakeholders within the industry have the power and capacity to influence the positive changes necessary to improve the state of the industry (Ofori 2012, 6). Currently, the approach the Ghanaian building construction industry is employing to tackle existing challenges is not cohesive and is adopted differently by the government and private organizations, rendering most efforts ineffective. This current approach is unstructured and contributes to a further challenge of meeting the demand for housing units. These "affordable" or low cost houses are traditionally built with local materials such as brick and tile, land concrete, adobe bricks, compressed earth bricks, pozzolana cement, bamboo, and secondary timber species to reduce costs (Twumasi-Ampofo et al. 2014, 8). This approach, however, has yet to align the notion of "affordable" with the real cost of the market (Twumasi-Ampofo et al. 2014, 8) and lacks common consensus among the stakeholders in the industry (Asamoah and Decardi-Nelson 2014, 63). This has often resulted in many building construction failures and is indicative of a lack of concise understanding and dialogue among stakeholders in the industry (Ampadu-Asiamah and Ampadu-Asiamah, 2013, 149).

Ofori (2012, 4) also explains that most construction projects in Ghana have a long gestation period due to their large and complex nature and thus are slow to respond to planned and unplanned changes. Therefore, there is a need to mitigate the sustainability challenges in the building construction industry by immediately integrating sustainability into its practices.

2.2 Sustainable Development & Construction in Ghana

A recent study about sustainability in the Ghanaian construction industry characterized the business as a robust sector, reliant, and dependent, on traditional methods of construction. As the industry has traditionally favored the use of blocks and concrete, it has made the entry of other alternative building material and services difficult. As such, clients and stakeholders do not demand innovative resources and solutions, relying instead on out-dated supplies (Djokoto et al. 2013, 136). Yet, despite the Ghanaian construction industry's reluctance to go beyond meeting the client's needs, the industry has managed to become more sophisticated and dynamic (Asamoah and Decardi-Nelson 2014, 63).

Despite a purported desire to adopt sustainable construction practices, the industry is further hampered by a lack of capacity to actually implement sustainable practices (Djokoto et al. 2013, 136). Professionals within the built environment are not yet fully trained in sustainable construction principles and thus lack the know-how to properly carry out such practises. In addition to forming an appropriate knowledge basis, these professionals would benefit from trainings in how to engage with owners/end users, investors, developers, designers, and contractors (Djokoto et al. 2013, 136). The lack of a solid knowledge basis as well as ineffective communications has resulted in delayed projects throughout Ghana (Ampadu-Asiamah and Ampadu-Asiamah 2013, 150).

As the timing of construction projects from inception to completion is critical to both clients and consumers due to increasing interest rates, inflation and development plan targets, the need for this training is particularly acute (Ampadu-Asiamah and Ampadu-Asiamah 2013, 150). Many of the construction projects in Ghana are becoming larger and more technical, and will require a higher quality of professional services and better control systems to meet the needs of the growing population (Asamoah and Decardi-Nelson 2014, 63). The need to invest in training skills is of paramount importance to the survival of the industry.

Djokoto et al. (2014) present ten main barriers that must be addressed before sustainable construction can be successful. These barriers are: lack of demand (by property owners), lack of strategy to move towards sustainable development, higher development costs, lack of public awareness, lack of government support, lack of cooperation, risk of investment, lack of building codes and regulations, higher investment costs and lack of a measurement tool.

2.3 The Green Star Building Rating Tool

Many types of tools are available to the construction industry, including sustainability assessment indicators, "used for providing summaries and to focus and condense the complex surroundings into a form of manageable indicators" (Suopajarvi 2011, 8). 'Building rating systems', also known as 'building rating tools', are one such type of sustainability assessment indicator.

Building rating systems were developed as a means for the construction industry to meet the sustainability challenge. They enable architects and contractors to take sustainability into consideration when designing and constructing buildings.

'Sustainable building rating systems' are defined as tools that examine the performance or expected performance of a 'whole building' and translate that examination into an overall assessment that allows for comparison against other buildings. For a rating system to add

value to the sustainable design and/or operation of a building, it must offer a credible, consistent basis for comparison, evaluate relevant technical aspects of sustainable design, and not be over-burdensome to implement and communicate" (Fowler and Rauch n.d., 1).

Building rating systems provide a 'road map' towards sustainability for the industry at a practical, everyday level. Systems outline what the industry must do to become sustainable. They function as guidelines in designing and constructing the building, as building codes and blue prints do in traditional construction projects. Clearer and more detailed blue prints and building codes will more likely result in the end product mirroring the envisioned concept. Similarly, clearer building rating systems will result in more sustainable buildings and practices.

Inherent in these systems is a recognition that sustainability is not something to be achieved or not achieved, but rather is achieved by degree. Accordingly, the methodology in this paper sought to understand to what degree building methods deployed by the industry could align more closely with sustainability, and led to the further question of how the existing system in Ghana could be improved upon to increase the level of sustainable construction.

There are many building-rating systems in use by construction industries around the world. The most prevalent are Leadership in Energy and Environmental Design (LEED) in North America; Green Star (G.S.) in Australia; Building Research Environment Assessment Method Consultancy (BREEAM) in the United Kingdom; Building Environment Assessment Method (BEAM) in Hong Kong; Comprehensive Assessment System for Building Environment Efficiency (CASBEE) in Japan; the Green Globe Rating System used worldwide; Energy Star in the United States; Green Rating for Integrated Habitat Assessment in India; and the Pearl Rating System in Abu Dhabi. A further description of each system is provided in Appendix I.

The Green Star v1 Building Rating Tool (GS-v1 Tool) is a building-rating tool that is used by Green Star in Australia. "Green Star is a comprehensive, national, voluntary environmental rating system that evaluates the environmental design and construction of buildings and communities" (Green Building Council Australia, n.d.). The specific purpose of the Green Star Tool is to establish a set of concrete, achievable targets that define sustainable construction. In essence, the Tool describes "sustainable construction" as defined in its basic form by the World Green Building Council. The need for the Tool arose in a broad sense from the sustainability challenge worldwide and in a narrower sense as a response to the construction industry's demand for a clear understanding for what a sustainable building looks like.

The Ghana Green Building Council is an independent association registered with the Registrar General's Department in Accra (Ghana) as a member-based non-governmental organization with no private ownership (GHGBC Handbook 2011, 8). Its Mission is "to transform the built environment in Ghana towards sustainability through the way our communities are planned, designed, constructed, maintained and operated" (GBC Handbook 2011, 11). The GHGBC has a license agreement with the World Green Building Council (W-GBC) to use the name and intellectual property of the W-GBC. The GHGBC is responsible for implementing the rating system in Ghana.

The GHGBC does not have its own building rating system today. There is, however, a building rating system in South Africa called the GS SA-v1 Building Rating System, which was adapted from the GS-v1 Building Rating Tool in Australia. This system is a result of a

license agreement between the South Africa Green Building Council (SAGBC) and the Australia Green Building Council (AGBC). The license agreement permits the SAGBC to make its certification process available to other countries in Africa using a sub-license agreement. Under terms of the sub-license agreement the GHGBC and the SAGBC have agreed to a building rating tool called the GS SA-GH-v1 Building Rating Tool (Osae-Akonnor 2014). The GS SA-GH-v1 Tool will also be referred to as 'the existing Tool' and 'the G.S. Tool.'

The GHGBC is in the process of developing its own building rating tool called the GS GH-v1 Building Rating Tool, which will be modeled on the existing Tool. The GHGBC chose the Green Star Building Rating System because of its ease of use, ease of customizing to Ghana, and because of the logical transition from the existing tool to its own tool (Osae-Akonnor 2014). Until the GS-GH-v1 tool is finalized, contractors wishing to obtain Green Star Certification in Ghana can apply for certification using the interim existing Tool. A summary of the Building Rating Systems is shown below in Table 1.

Green Building Council:	**Building Rating System:**	**Status:**
Australia (AGBC)	GS-v1 Tool	Existing, used in Australia
South Africa (SAGBC)	GS SA-v1 Tool	Existing, used in South Africa
Ghana (GHGBC)	GS SA-GH-v1 Tool ('G.S. Tool')	Existing, used in Ghana
Ghana (GHGBC)	GS GH-v1 Tool	In development in Ghana

Table 1: Green Star Building Rating Systems in Australia, South Africa and Ghana.

The Tool (including the three existing tools and the Ghana tool in development) consists of eight categories of sustainability-related issues: Management, Indoor Environmental Quality, Energy, Transport, Water, Materials, Sustainable Site Development (formerly called Land Use and Ecology), and Emissions. A description of each of the categories is listed below (GHGBC Handbook 2011, 68-69):

Management
Ensures sustainable development principles from project conception through design, construction, commissioning, tuning and operation.

Indoor Air Quality
Addresses occupant health, comfort, and productivity issues in terms of thermal comfort, lighting and contaminants.

Energy
Targets an overall reduction in non-renewable energy consumption, to achieve an impact on greenhouse gas emissions.

Transport
Targets reduction of individual use of cars and encourages alternative forms of transport.
Water
Targets reduction of potable water consumption, and encourages the use of recycled and rain water.

Materials
Targets the consumption of resources through selection and reuse of materials, and efficient management practices.

Sustainable Site Development
Addresses impact on the immediate ecosystem, encourages preservation and restoration of flora and fauna.

Emissions
Addresses negative emissions from development to the atmosphere, watercourse and local ecosystems.

Each category consists of a series of credits describing criteria that represent a desired level of sustainability. Points are awarded for each credit achieved in the construction process. For example, under Indoor Air Quality, contractors can earn a point for installing ventilation systems that provide fresh air to a building. The more points a project earns, the higher the rating and the greater the degree of sustainability of the project (Osae-Akonnor 2014). A table of the categories and their respective credits is available in Appendix II.

Additionally, credits are weighted according to their respective contributions to sustainability. Water for example is both extremely important in terms of its value to a project and its increasing vulnerability due to the climate crisis. Thus water-related credits are weighted more heavily than other credits in the Tool. Water is also weighted more heavily in countries like Ghana that are vulnerable to water shortages due to population growth and drought. Less weight is given to energy than in other areas such as South Africa because energy is less of an issue in Ghana with its abundance of oil, gas and biomass sources of energy (Braune n.d., 2).

Overall the use of the G.S. Tool is a move in the direction towards sustainability in the construction industry in Ghana. There are, however, deficiencies in the Tool, which if corrected could result in a greater level of performance in terms of sustainability.

First, the existing Tool was adopted from the Australian G.S. Tool for South Africa, not Ghana, and thus is designed for the construction industry of South Africa. The basic eight categories are applicable in Ghana, but the individual credits and the weightings for the credits are not equivalent for both countries. The importance of water conservation, for example, as noted above, is different in the two countries.

A second problem with the existing tool is that it is insufficient to meet the sustainability challenge of our time because it fails to take changing market needs and desires into consideration. There will be an increasingly greater need for access to public transportation, for example, as traffic from rapid urbanization and building construction increases. The existing weighting of the Transport credits will need to take the public's increasing need for greater access to public transportation into account.

A third deficiency of the existing Tool is its failure to consider emerging products in the market, such as technical innovations that are driving needs, desires and construction practices. Alternative energy sources such as solar arrays, windmills and geo-thermal power are becoming increasingly available, driving demand up and prices down. Their wide availability changes the weightings that will be assigned to each credit. Availability of solar panels, for example, puts more weight on the credits of the Energy category because contractors are expected to use and are rewarded for using innovative technology as it becomes available in the marketplace.

A fourth deficiency of the Tool is its failure to identify points of influence in the process to move towards sustainability - that is, stakeholders who can either facilitate or hinder progress towards sustainable actions. Contractors would benefit from understanding who has the power to assist or block an action towards sustainability.

Finally, the existing Tool fails to consider the interaction among different actions towards sustainability. Contractors must often make choices between seemingly competing actions, such as purchasing locally produced non-recycled steel versus imported recycled steel. The existing Tool fails to adequately inform the contractor as to the conflict between the choices, or how to make such a decision. The Tool also fails to offer criteria by which contractors can prioritize various options.

To address the shortcomings of the existing Tool and help improve the Tool's performance to guide the industry towards greater sustainability, a model was explored that could be applied to each credit of the Tool, as described below.

2.4 The Template for Sustainable Product Development

The Template for Sustainable Product Development was chosen for its application of a whole systems perspective and for its consideration of future changes in customer demand due to the changes brought about by the sustainability challenge. TSPDs are tools that can provide a quick, early overview of the sustainability performance of a general product type (Robèrt et al 2010, 231).

The purpose of the TSPD is "to help product development teams to arrive faster and more easily at an overview of the major sustainability challenges and opportunities of a product category in the early phases. The idea is also to inform creative communication among top management, stakeholders, and product developers…. By *products*, we mean physical artifacts, software, processes, services, or combinations of these systems" (Ny et al 2008, 600 and 621).

"The early part of the product innovation process is a critical intervention point for the transformation of society towards sustainability" (Ny et al 2008, 601). Because the GHGBC is in the early phase of forming its own building rating tool, the TSPD could be effective in assisting the GHGBCs technical team developing the new tool to shape the specific credits and weightings of the tool.

"The template approach is based on a framework for strategic sustainable development that aims at clarifying how our future society must be constituted on the most basic level to be sustainable. This framework also suggests how organizations can plan and act to support society's transformation toward such a society while avoiding financial risks associated with unsustainable practices and foreseeing new business opportunities" (Ny et al 2008, 602).

In terms of the construction industry in Ghana, the 'organization' as defined by the TSPD is all stakeholders moving collaboratively towards sustainable construction. It is anticipated that the GHGBC will initiate the process since it is the GHGBC that owns and is developing the GS Tool, and because it is aligned with GHGBC's mission 'to transform the built environment in Ghana towards sustainability" (GBC Handbook 2011, 11). Using the Tool as the platform and MSD as the process, the GHGBC has an opportunity to lead the industry in its effort to become sustainable.

Ny et al (2008, 606) explain that the TPSD consists of three separate templates. Template I (Market Needs and Desires) focuses on market desires and their basic human needs and on identifying the desired product function. Template II (Product Concepts) focuses on life cycle sustainability consequences of meeting the market desires with a certain product concept. Template III (Extended Enterprise) focuses on societal stakeholder consequences from the product concept and on how they can be influenced. The templates are illustrated in Table 2 below.

	I. Market desires/needs	**II. Product concepts**	**III. Extended enterprise**
Current situation	Current market desires	Current products	Current stakeholders
Future possibilities	New market desires	Redesign of current products or develop new products	Future societal stakeholders

Table 2: Traditional Template for Sustainable Product Development (Ny et al 2008, 607).

In the context of the construction industry, Market Needs and Desires are the needs and desires of the consumers who occupy the buildings. In terms of Max-Neef's Fundamental Human Needs (Max-Neef 1992), fundamental needs relevant to buildings are primarily protection (security) and comfort (leisure). In Ghana, the Product Concept satisfying the basic needs are low-rise buildings with outdoor gardens (Atongo, 2014). In general consumers prefer low rise, single-family homes over high-density, high-rise buildings, both as a sign of prosperity and more comfort. To fulfill this basic market demand, contractors build 'horizontal development'– that is, building low-rise, single family residences on extensive plots of land. "Construction is driven largely by the consumers' desires, not by consideration of the sustainability challenge" (Atongo 2014). The Extended Enterprise consists primarily of the property owner, architects, contractors, regulators (government agencies overseeing the construction), and the consumers (occupants of the buildings).

When sustainability principles are taken into consideration, construction then considers the impact of development on the environment, both ecologically and socially, and products are designed to meet the changing needs and desires. The extended enterprise is expanded to include not only the traditional stakeholders (property owner, architects, contractors, regulators, and property occupants), but additional stakeholders as well, such as commissioning agents, NGOs, and society at large. The range of stakeholders is increased

because the impact on the environment and society is increased as well when sustainability is taken into consideration. NGOs concerned about environmental degradation and social equity, and neighbors impacted by noise, parking and traffic issues become invested in the construction project, and thus vocal participants in their development. Table 3 below illustrates the three templates in the context of the construction industry.

	I. Market desires/needs	**II. Product concepts**	**III. Extended enterprise**
Current situation	Basic needs of housing, security, comfort	Horizontal development; little consideration given to sustainability	Property owners, architects, contractors, regulators, consumers
Future possibilities	Impact of sustainability challenge on housing, security, comfort	Vertical development; gated communities	Property owners, architects, contractors, regulators, consumers + NGOs, society at large

Table 3: Template for Sustainable Product Development as applied to the construction industry.

By applying the concepts of the TSPD to the G.S. Tool, the construction industry can more readily anticipate emerging needs, concepts and stakeholders and improve planning for the impacts construction in Ghana are having on the environment.

2.5 The Green Star Building Rating Tool as informed by TSPD – The "Matrix"

In an effort to improve the existing Tool, this paper proposes a two-step process (Figure 1):

Step 1: Design the "Matrix" – the existing Tool as informed by the TSPD and MSD.

Step 2: Use the Matrix to develop the G.S. Gh-v1 Tool, as described in the Results and Discussion sections below.

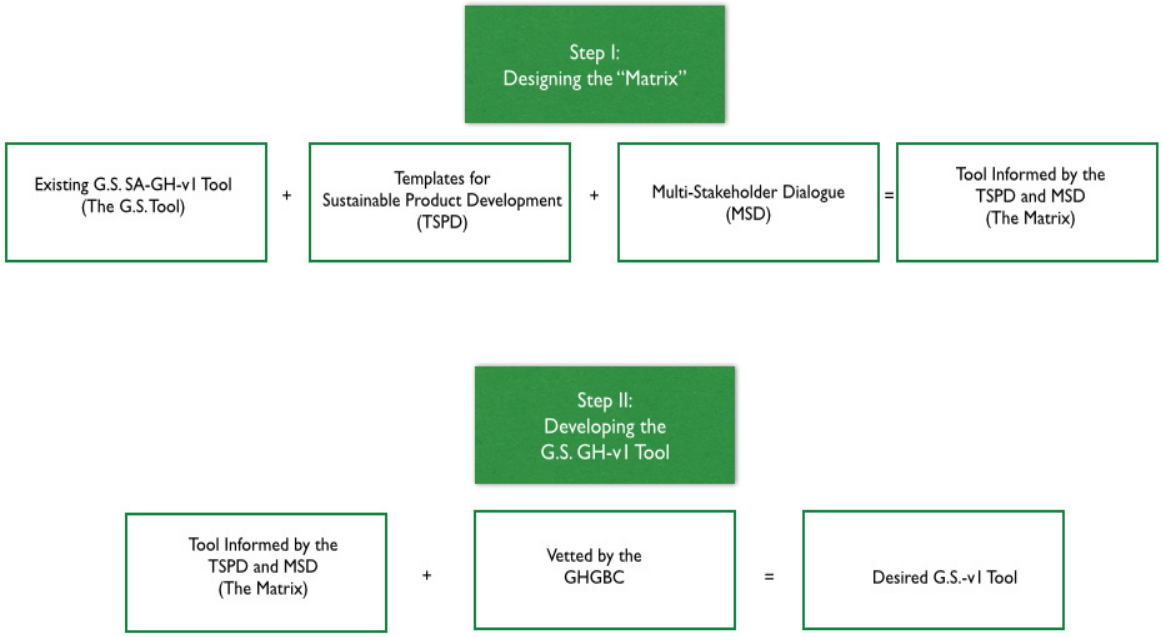

Figure 1: Process to develop the new Green Star GH-v1 Building Rating Tool

The existing G.S. Tool consists of eight categories, discussed above, and 66 credits, shown in detail in Appendix II. A matrix, referred to throughout the rest of the paper as the 'Matrix', was constructed informing the GS Tool with the TSPD. The Matrix provides a 'snapshot' view of the factors that influence sustainable construction. The rows of the Matrix consist of the eight categories and 66 credits. The columns of the Matrix consist of the six templates of the TSPD. Two columns in addition to the standard six templates of the TSPD were added: 'Challenges and Opportunities' and 'Points of Influence.' Figure 2 shows an example of the templates as they relate to the category 'Water.'

	Challenge	**Market Need Current**	**Market Need Future**	**Product Concept Current**	**Product Concept Future**	**Extended Enterprise Current**	**Extended Enterprise Future**	**Point of Influence**
Water	Drought	Water shortages	Increasing shortages	Insufficient and vague regulations	Tighter enforcement of regulations	Industry opposes changes	Awareness and training programs	Ghana Building Dept.

Figure 2: The Templates of the TSPD as they relate to the category 'Water.'

Upon consultation with the Executive Director of the GHGBC, the 'Points of Influence' column was subsequently divided into two columns – 'Advocate for Change' and 'Points of Influence', discussed in more detail in the Results section below. The resulting Matrix was populated with the challenges, opportunities, needs, barriers, stakeholders and actions that the industry must consider to build towards maximum sustainability as defined by the construction industry itself.

In the context of the construction industry, the intent of applying the TSPD to the G.S. Tool is not to make the Tool more sustainable. The Tool is only a guideline for the process of designing the end product – the building. The intent of applying the TSPD to the G. S. Tool is to make the provisions of the Tool as clear and precise as possible. A clearer Tool, taking into consideration not only today's needs, product concepts and stakeholders but future ones as well, will result in an end product (a construction project) with reduced ecological and social impacts on the environment.

The Matrix can be used at three levels: by the GHGBC technical team developing the GS GH-v1-Tool; by contractors and commissioning agents who will be using the Tool in the field; and by all stakeholders as part of the MSD process.

First, the Matrix will assist the GHGBC technical team in developing the proposed GS GH-v1 Tool. Taking into consideration the relationships among the credits and stakeholders, the challenges associated with complying with each credit, the emerging trends and products in the marketplace, and the points of influence should benefit the technical team in assigning the credits and weightings of each credit as appropriate for Ghana. An important step in developing the Matrix is to involve stakeholders early on in the development process, as part of the MSD process. The technical team can use the Matrix as a guide as to whom to include in the development process, and as a part of the planning process itself. Including the shared wisdom and multiple values and visions of the disparate stakeholders will greatly benefit the development of the new GS GH-V1 Tool.

The Matrix also provides examples of where the technical team and other interested stakeholders can form partnerships with other groups with similar visions of sustainability. The team, for example, can partner with bicycle coalitions to petition the government for bike lanes and alternative forms of transportation. The changing market needs, product concepts, extended enterprise and points of influence columns all provide examples of areas of opportunity for collaboration and partnerships.

Second, understanding the relationships among credits and stakeholders will assist those who will be using the new GS GH-v1-Tool (primarily contractors and commissioning agents) to understand the purpose of the Tool and to make choices among sometimes competing options. For example, contractors may need to choose between using local non-recycled steel or imported, recycled steel. Local, recycled steel in not currently available in Ghana. The Matrix demonstrates the emerging need for local, recycled steel, and pinpoints the government as the Point of Influence and local steel manufacturers as the initiators of change. That is to say, local steel manufacturers can petition the government to implement policies that will provide incentives to local steel manufacturers to produce recycled steel - a practice that is currently cost-prohibitive without government subsidies.

The Matrix can also help contractors and commissioning agents to compile and submit their Builders User Guide – the document describing the process and materials used during a construction project and upon which the GHGBC assigns a rating to the project. The Matrix can help those completing the Builders user Guide by providing clearer understanding of the intent behind the respective categories and credits, and the ramifications of complying (or not complying) with the credits. Such an understanding is not readily apparent in the existing application process.

Third, the Matrix can be used in the MSD Process itself, not only in the development of the GS GH-v1 Tool (above), but in using the Matrix itself as a guideline in the actions the

stakeholders will undertake moving forward. The Matrix, for example, can focus MSD participants on identifying clear objectives, using common language, and creating strategies to target priority areas and decision makers.

In summary the Matrix is a tool to help create the GS GH-v1 Tool now in development; guide contractors in the field as a reference towards completing their Building Users Guide; and assist stakeholders in participating in the creation of the proposed GS GH-v1 Tool and in their planning process on an on-going basis. The complex nature of the challenges and relationships among the credits and stakeholders indicates the need for a holistic, strategic approach to sustainable construction. The Matrix can assist the developers of the GS Tool in better designing and explaining the Tool to the industry and the users in understanding the purpose the Tool and ramifications of their choices. The Tool also anticipates the needs of the construction industry and allows the industry to consider and focus on conditions and linkages that they may not have previously considered.

2.6 Multi-Stakeholder Dialogue Process

The TSPD serves to "facilitate consensus among organizational levels about major sustainability challenges and potential solutions for a product category, and facilitate continued dialogue with external sustainability experts, identifying improvements that are relevant for strategic sustainable development" (Ny et al. 2008, 600). Inherent in the TSPD is a reliance on multi-stakeholder dialogue as a conduit for the inclusion of sustainable practices throughout the construction industry. This approach encourages a more holistic, strategic approach to sustainable construction whereby industry stakeholders are better able to navigate the power dynamics that both inspire and obstruct actions towards sustainability.

Overview

Internationally, the most popular cases of multi-stakeholder discussions have been taking place at the United Nations Commission on Sustainable Development. Since the 1990s there has been a significant increase of multi-stakeholder processes within the areas of environment and sustainable development (Hemmati 202, 7). UNED Forum suggests that multi-stakeholder processes aim "to bring together all the major stakeholders in a new form of communication, decision-finding (and possibly decision-making) structure on a particular issue" (Hemmati et al. 2001, 16).

Authors Ebohon and Rwelamila (2001, 5) state that "with the significant impacts the construction industry has on the environment, the real challenge is to find ways of achieving dramatic shifts in attitudes in the different areas of the construction process."

There are numerous aspects asserting the use of stakeholder processes as a means to discuss important issues and reach decisions, including the notion that they introduce a greater variety of information and dimensions of a problem than traditional regulatory processes and the interaction among different stakeholders often generates more creative solutions to problems than would have occurred in the absence of such a process. Another important aspect is the relationship building that occurs and that has the potential to last beyond a particular dialogue process and yield beneficial results in addressing subsequent issues. Finally, participation in a multi-stakeholder process can improve an industry's transparency, accountability and trust amongst constituents. Proponents of a study on stakeholder process for environmental decision-making observed that many of these factors "do not generate

improved environmental performance per se but, rather, represent a means to this end" (Yosie & Herbst 1998, 51).

Key characteristics

There are several characteristics essential for successful multi-stakeholder dialogue processes that appear in theoretical and practical literature on the subject. There are ten characteristics that surfaced during the literature review that were further validated during expert interviews in the context of this paper's research.

Clear Objective	The dialogue must have a clear objective
Inclusion	All key stakeholders must be invited to participate in the discussion
Participation	Stakeholders must be allowed to fully participate in the discussion
Transparency	All relevant information must be made available to all stakeholders.
Actively involved representative	One (at least) individual must agree to actively represent his/her industry
Rapport/Trust	Participants must build rapport with one another and with the institutions they are trying to influence
Accountability	Participants must be held accountable for their actions and responsibilities.
Common Vocabulary	Participants must readily understand one another's industry jargon
Capacity & Resources	Participants must be capable of performing the tasks they have agreed to undertake
Organizational capacity	Process must include managerial actions like producing agendas, timelines, meeting minutes, etc.

Figure 3: List of 10 key characteristics of MSD process

All of these elements are interlinked and need to exist in conjunction with each other (Commey 2014; Bukari Braimah 2014).

Some of the key objectives of an MSD are to enhance levels of trust between the different actors; to share information and institutional knowledge; and to generate solutions and relevant good practices. The process takes the view that all stakeholders have relevant experience, knowledge and information that ultimately will inform and improve the quality of the decision-making process as well as any actions that may result. "With sufficient time, resources and preparation, an MSD can be a very effective tool for bringing diverse constituencies together to build consensus around complex, multifaceted and in some cases, divisive issues" (Dodds & Benson 2010, 1). Furthermore, it is a flexible process and can be adapted to a number of different contexts.

Yosie and & Herbst (1998, 29) share that "regular communication, for example, helps bolster accountability among participants during the process by ensuring that they are accurately representing the interests they claim to represent." The World Bank (1995, 135) has concluded that sponsoring organizations have an obligation to "ensure that stakeholders are provided with adequate and relevant information" and that the information is "provided in a meaningful" and "readily understood" manner. In a series of interviews conducted in Herbst and Yosie's paper on *Using Stakeholder Processes in Environmental Decision-making* "respondents identified certain goals that should be established early in the process, including enhanced trust and credibility, relationship building, agreeing on the design of a stakeholder process, procedures for information gathering, and others" (Yosie & Herbst 1998, 25).

Stakeholders

The multi-stakeholder approach asserts that influence and the right to be heard should be based on the value of each stakeholder's unique perspective and expertise. This kind of participatory process could "increase creative thinking, commitment to implementation and multiplying effects in order to address problems such as resource depletion and human and environmental security" (Hemmati 2002, 7). In order for this to be the case, stakeholders must be strategically selected and the process contextually designed, taking into account aspects particular to the construction industry in Ghana. Industry stakeholders include the architects, builders, the financial industry, local and national governments, the providers of many kinds of services associated with the use and maintenance of buildings, and the firms, organizations and households that either own or occupy buildings. "The identification of stakeholders is influenced by such factors as the issues under consideration, the methods used to evaluate whose views need to be solicited, and the skill at which individual stakeholders or their organizations articulate their interests" (Yosie & Herbst 1998, 2).

Many players exercise considerable influence at various stages of the building process, including design, construction, maintenance, building use and demolition. They include the architects, builders, the financial industry, local and national governments, the providers of many kinds of services associated with the use and maintenance of buildings, and the firms, organizations and households that either own or occupy buildings. "Unless these players quickly embrace the rapidly unfolding environmental realities where changes to the global physical and biotic environment are becoming irreversible, the problems would not only persist but the consequences could become unmanageable" (Ebohon & Rwelamila 2001, 6).

On an individual level, each stakeholder has an interest in the topic bringing everyone around the table and each brings his or her unique capacities to the challenge. For example,

"government officials have an interest in getting 'value for money' out of construction contracts, and they contribute political legitimacy and knowledge of the procurement process. Construction contractors have an interest in achieving fair competition, and they contribute an understanding of the industry and technical knowledge to interpret contract information. Civil society organizations have an interest in reducing government malfeasance, and they contribute broader societal legitimacy and an institutionalized link between citizens and the state" (Ebohon & Rwelamila 2001, 10).

A recent study from Germany cited in Wallbaum and Buerkin's research on *Concepts and instruments for a sustainable construction sector* found that the large majority of stakeholders asserted the need for multi-stakeholder cooperation. "Many went so far as to state that it represents the only viable solution to avoid misleading incentives and to improve industrial governance" (Buerkin & Wallbaum 2003, 56). "The inclusion of all affected parties can facilitate the development of patterns, structures and buildings that are sustainable in the social, ecological and economic dimensions" (Feige, Wallbaum and Krank 2011, 504).

The existence of a thriving construction industry and participatory stakeholders are fundamental to the sustainable construction strategy. "It is clear that these stakeholders do not just exist in name but are empowered to function and remain active, which is vital to any consultative process on sustainable construction. This is an experience that cannot be taken for granted in the developing countries where the construction industry and associated trades and institutions exist largely in name, which challenges the scope for the sustainable construction process in these economies" (Ebohon & Rwelamila 2001, 8).

Challenges

The multi-stakeholder dialogue approach gives rise to considerable criticism and skepticism. "Critics mostly refer to these processes as merely serving as an alibi for political inertia" (Buerkin & Wallbaum, 2003, 56). Furthermore, they fear that solutions will be limited to the lowest common denominator among the actors involved instead of leading a big step towards sustainable development. The constraints can be found in the organizations themselves, the relationships among the different actors, and general considerations such as the sector's economic situation (Buerkin & Wallbaum 2003, 56). More basically, "operating a stakeholder process can be an expensive, time-consuming activity involving many different kinds of resource needs" (Yosie & Herbst 1998, 28).

Truex and Søreide (2010, 3) list a number of potential challenges to an MSD process that include "poor participation among members due to time constraints or conflicts of interest; problems reaching consensus on key decisions; imbalances of power and capacity across stakeholder groups; a lack of broader social and political legitimacy; difficulties obtaining needed inputs; and insufficient time as a result of external deadlines."

A 2009 report by the United Nations Environment Program (UNEP) Sustainable Building Initiative (SBCI) pointed to the fragmentation of the building sector in general as a barrier to stakeholder collaboration. It supports that statement by pointing out that buildings normally have a long life cycle with only limited interaction among stakeholders involved in different phases of the buildings' lifetime and that different aspects of the buildings such as architecture, engineering, building management, building function, and occupant behavior are often poorly or not at all coordinated. It states that inevitably there is "no natural incentive for stakeholders to cooperate to maximize the overall long-term energy efficiency of the building" (UNEP 2009).

Another barrier pointed out by this report is lack of information and understanding of the importance of the building sector in relation to climate change, or to the sustainability challenge. Becoming acquainted with the green building tool is an effective way to address this issue. Accurate data and information are critical to achieving an effective sustainable construction process and information is needed on building materials used in construction, including the types of materials, how they are employed and the amount consumed. Similarly, it is important to have accurate information about the number of construction operatives, their mode of operation and the sectors in which they operate, which are essential to being able to influence their environmental behavior and practices (Ebohon & Rwelamila 2001, 13).

The multi-stakeholder ideal holds that each stakeholder will have input into the process and contribute its comparative advantage, but in practice, multi-stakeholder dialogues "may be constrained by imbalances of power and capacity across stakeholder groups …this 'missing stakeholder' problem may be particularly pervasive in initiatives concerning complex government processes like construction, as there are generally few local NGOs even focused on such issues, let alone with the capacity to engage effectively" (Truex and Søreide 2010, 8).

In addition to the identified lack of communication among industry stakeholders in Ghana through the conducted interviews, it was also found that there is a general lack of clarity with regards to who is responsible for what actions or decisions. This ties back to the building Tool's failure to identify points of influence in the process to move towards sustainability and the importance of addressing this issue. In his model called the circle of blame, Cadman states that members of the building sector often do not strive for sustainable buildings because others in the sector are not striving for sustainability. "The circle of blame needs to be broken at some point by introducing adequate incentives for starting an entirely new movement towards sustainability" (Cadman 2007).

Case Study | International

One example of an initiative to gather stakeholders and put forth efforts for a movement towards sustainable building is the creation of the Network for Sustainable Construction Switzerland, designed to "influence business and enhance the share of sustainable construction in Switzerland (Swiss Federal Council 2008)." This network that is part of the Swiss Federation's Sustainable Development Strategy 2008–2011 and whose strategy is comprised of five main initiatives "demonstrates how to foster sustainable construction by including a wide range of stakeholders" (Feige, Wallbaum and Krank 2011, 504). One of the project's initiatives is "strengthening the Network for Sustainable Construction Switzerland" (Swiss Federal Council 2008) with the aim of creating a network with all of the relevant stakeholders of the construction sector and working together on a set of measures to foster sustainability and sustainable building.

"The success factor of this initiative is its meta-position; it involves a broad range of stakeholders without focusing on a concrete project. Thus, incentives are defined before the actors are involved in a concrete project, and the circle of blame can start" (Feige, Wallbaum and Krank 2011, 513). One of the main takeaways includes a need for financing through government funds and member fees. Stakeholders interviewed on the outcomes of this network pointed to the need for a structured network and a multi-incentive approach. "Without exception they categorized the implementation of the network as a topic with high relevance. It was also seen as a chance to overcome several uncoordinated activities that were

causing uncertainties. However, within the feedback interviews the need for a strong leadership of the Network has been requested to handle the complex organization of the planned initiatives" (Feige, Wallbaum and Krank 2011, 513).

This case demonstrates one way to foster sustainable construction by including a wide set of stakeholders. However, the network is not an easy solution and requires a budget to facilitate collaboration and extensive long-term planning and execution. Additionally, its success will be hard to prove, even if its initiatives are to be evaluated by an external commission that will be assigned by the Swiss Federal Council. "Only the number of active members within the network will give a hint about its success" (Feige, Wallbaum and Krank 2011, 513).

Case Study | Ghana

While examples of multi-stakeholder dialogues in Ghana are limited, and ones specific to the Ghanaian construction industry non-existent, there are examples of employed participatory methods in different sectors such as the forestry sector.

Starting in 2009 and due to continue through 2015, a Voluntary Partnership Agreement (VPA) between the government of Ghana and the European Union was ratified, aiming for the legal production of timber. This agreement includes production for the domestic market, for which more than 80 percent of demand is met by chainsaw-milled lumber. Since the production of and trade in chainsaw lumber is illegal in Ghana, the aim of the implementation of the VPA is to have a significant impact on local livelihoods and on timber production. The chainsaw-milling project is using multi-stakeholder dialogue as the key mechanism for developing a consensus based action plan addressing the problems associated with chainsaw milling. Between 2009 and 2012, 72 MSDs were held (Mckeown, Rozemeijer and Wit 2013, 1).

Reports on this project state that applying the principles of a multi-stakeholder process in the MSD design and facilitation has led to a significant reduction in conflict in the domestic timber market. They show that MSD has been pivotal in allowing stakeholders to review and renew relevant policies and that the project has achieved some successes such as bridging the differences among antagonizing actors within the domestic timber sector and agreeing on a draft policy for supplying legal lumber to the domestic market as well as for a public procurement policy on wood and wood products. Even though illegal logging and deforestation have not ended, the lessons learned in the design and facilitation of the MSD and in applying the core MSD principles suggest that developing policies in this manner is more supportive of sustainable forestry than conventional command-and-control regimes. This is true, however, if and only if these principles are institutionalized in the decision-making processes.

Over the years, the dialogue process was supported by necessary and valuable research data and by practitioners' knowledge to inform the debate and raise awareness among stakeholders on the scope and complexity of the problem and on possible solutions. For a successful integration, there are certain areas that need further discussion, such as mutual recognition, facilitation, administration, and structure in terms of stakeholder representation and financial support. To support this process, a five-member committee was inaugurated to develop a working document with inputs from district level stakeholders and a discussion paper to be prepared by a consultant. There was also an identified need for sensitization meetings initiated to respond to an initial lack of confidence of stakeholders in the relevance and impact of an MSD.

Below are six identified requirements by the project for successful application of an MSD process in the Ghanaian context (Mckeown, Rozemeijer and Wit 2013, 1):

1. The Government of Ghana, most notably the Forestry Commission, supports the MSD as an all-inclusive forest policy development mechanism;
2. The formal industry supports this approach;
3. Civil society organizations are less dependent on foreign donor funds and more able to take on advocacy and facilitation using local resources from either the sector itself or national funding;
4. Grass roots interests are organized and are represented in accountable organizations;
5. Similar initiatives in the forestry sector are aligned with the MSD; and
6. The process remains focused on addressing the root causes of illegal logging and unsustainable practices, such as land and tree tenure and benefit sharing mechanisms.

The project is reported to have achieved enhanced levels of trust amongst stakeholders through the provision of a mechanism for stakeholders to share information, interact and participate in the decision-making process. The project also supports the notion that capacity building and accurate information are important ingredients of the MSD process.

Though conducted in a different sector, this example showcases the evidence that an extensive MSD process is possible in Ghana if planned thoroughly while taking into account the interests and profiles of the stakeholders. Diversity of values, opinions, expectations and perspectives among stakeholders is expected but need to be properly managed to turn it from a liability that can significantly impede project success into an asset.

During a conference organized by the Royal Institution of Chartered Surveyors EU Public Affairs Office in 2008, entitled *"Investing in a Sustainable Built Environment – do energy efficient buildings make economic sense?"* participants discussed the roles of stakeholders in working towards a sustainable construction industry and ways to break the cycle of blame that is predominant in the sector. One of the main takeaways was that "taking sustainability issues into account can truly result in real win-win situations for all stakeholders in the property sector as numerous case studies from around the world have shown. Implementing the principles of sustainable development within property-related decision making is a highly profitable exercise and unsustainable property investment and management practices will result in losses with regard to asset value and financial performance" (Hartenberger 2008, 8). Through the research done to produce this paper, the same conclusion is drawn, while realizing it will be a very challenging task to achieve.

3 Methods

This thesis utilises qualitative research methods based on interviews. The following section describes the process that was used to answer the paper's research questions. All interview and survey questions were designed within the Framework for Strategic Sustainable Development, elaborated on below.

3.1 Research Approach

The data collection stage of this study was designed in two phases: Phase I Data Collection and Phase II Data Analysis, as shown in the figure below (figure 4).

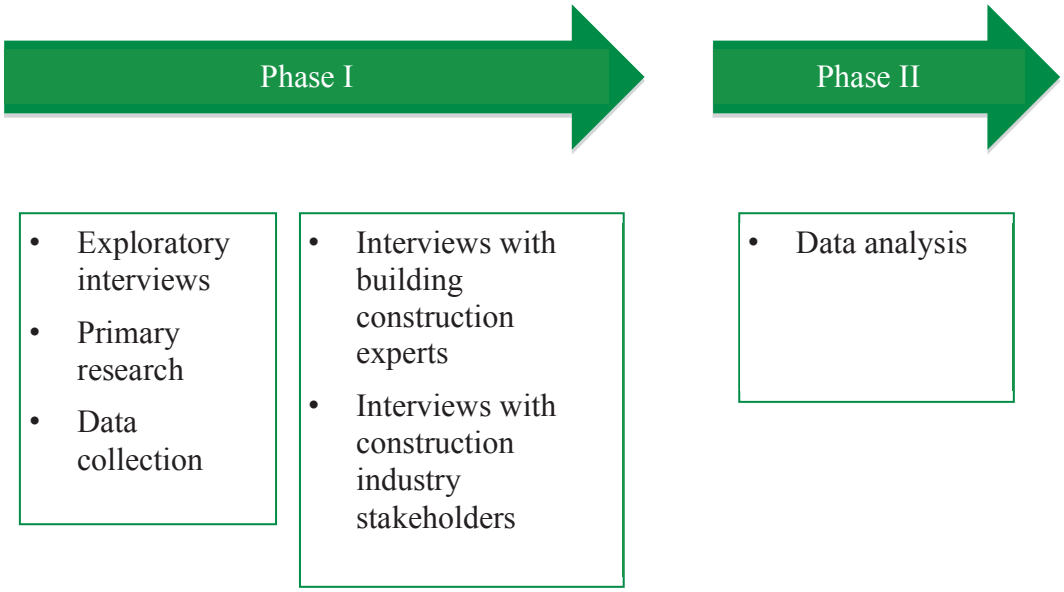

Figure 4: Phases of Research

Strategic Sustainable Development is a framework for systematically planning towards compliance with basic principles for sustainability (Robèrt 2002, 242). The Five Level Framework (5LF) is a type of strategic sustainable development framework that aids in analysis, decision-making and planning in complex systems. The Framework for Strategic Sustainable Development (FSSD) applies the 5LF in complex systems in order to plan with sustainability towards the desired outcome (Robèrt et al 2010, 258). It is through this lens that the research was designed and results were analyzed.

3.1.1 Phase I | Data Collection

This step in the methodology consisted of three interviews. Using both Skype (Internet-based) and phone conservations, outlined exploratory questions (see Appendix III) were posed to gauge the current state of the building construction industry and sustainable development in Ghana. This step in the data collection helped guide the relevant research questions addressed in the study.

Ghanaian Construction Industry's Expert Interviews

The Ghanaian construction industry experts, including Executive Director of GHGBC, Executive Director of GREDA and Managing Director of AESL, Ghana were interviewed**.** These experts were selected based on their current involvement in the construction industry and/or their involvement in efforts towards making the Ghanaian construction industry sustainable or are likely to influence innovation or a change in the paradigm of the industry. In-person interviews were granted in Accra, Ghana, with at least two research team members at each interview. All the interviews were recorded and transcribed.

Ghana Construction Industry Stakeholder Interviews

Stakeholders of the construction industry can play an important role in influencing sustainability in the Ghanaian construction industry. The interview questions were designed to understand the interviewees' knowledge of the topic and the various advancements being made toward sustainability in the country, if any. All the interviewees were asked 20 questions which served as a guide throughout the process (see Appendix IV). Seven in-person interviews were conducted among stakeholders who have a direct influence on the Ghanaian construction industry, including architects, academics, local building contractors, the general public and tenants and a consultant. The interviewees and interview dates and lengths are listed in Appendix V. Their respective responses were recorded and transcribed accordingly.

Survey

One hundred and eighty surveys were distributed in April, through an online site called Survey Monkey, among 17 different stakeholders in the Ghanaian industry. Another 80 surveys were distributed in May through the same platform. The survey questions were designed to learn about stakeholders' perceptions on barriers to sustainability, multi-stakeholder dialogue and the Green Star building-rating tool to facilitate the implementation of sustainable development in the Ghanaian industry. Many of the questions asked recipients to rate from 1 (strongly disagree) through to 5 (strongly agree). An 'I don't know' option was also provided. The recipient lists (or email addresses) were generated from the GREDA brochure, newspapers and membership list, GHGBC members, and affiliated companies and individuals who are involved in the Ghanaian construction industry.

3.1.2 Phase II | Data Analysis

Exploratory Interviews

The responses obtained from the construction experts were first coded along the five levels of the FSSD. This process identified gaps and common themes towards making the Ghanaian construction industry sustainable (see Appendix VI). The identified gaps subsequently influenced the study's research questions and the questions to be asked during the next interviews with experts and stakeholders

Ghana Construction Industry Expert and Stakeholder Interviews

At this stage, a second coding was conducted aimed at identifying similarities and patterns among the response from the interviews. These similarities and patterns in responses were further analysed to address the two research questions. For research question one, the

stakeholder and expert responses were analysed to determine if the Ghanaian construction industry were receptive to sustainable development in the industry. For research question two, the interview responses were analysed under two general concepts (i.e. Modification of the Green Star Tool and Informed by the TSPD as a sustainability oriented tool and multi-stakeholder dialogue as a process).

Modification of the Green Star Tool as Informed by the TSPD

The Matrix was reviewed through interviews with the Executive Director of the Ghana Green Building Council to comment on its applicability to the G.S. Tool. The Executive Director was chosen to review the matrix because the GHGBC is responsible for its creation and use by the industry. The Matrix was revised according to comments and suggestions from the Executive Director. Only a sampling of the cells was reviewed due to time constraints during the interview process.

Multi-Stakeholder Dialogue

The relevant information from the interviews particular to the process of multi-stakeholder dialogue for sustainable development in the Ghanaian construction industry was analysed. Researchers used the ten characteristics of MSD identified in the literature review as coding keywords while listening to the recordings of the interviews.

Survey

The analysis of the survey was performed on a survey monkey Internet-based software. The analysis was classified according to type of stakeholder, years of experience in the construction industry, environment and sustainability concerns, multi-stakeholder dialogue and sustainable development, importance of ten elements for multi-stakeholder dialogue and an implementation of a construction tool for sustainable development. Of the 260 surveys that were distributed, 10 responses were received.

3.2 Validity

Each interview was started with an explanation of the purpose of the research, and each interviewee was given the option to remain anonymous, or to withdraw his participation at any point of the interview. No interviewee chose either option.

In order to identify and address validity threats, each interview was conducted with at least two thesis members present.

Finally, during the interview process, cautious efforts were made to gain clarification from interviewees so that the data collection was not being misinterpreted or influenced by bias.

4 Results

This section includes findings collected through the methodologies outlined above. From the second coding, 7 key constructs emerged from the interview responses (environmental impact, land entitlement, building codes, human impact, awareness, stakeholders and financial problems). These constructs were utilized to answer the research questions. The results do not include findings from the survey conducted online as there were only ten responses. This was considered too small of a respondent sampling and the responses were therefore not considered in this study.

4.1 Research Question 1

"Are stakeholders in the construction industry in Ghana open and receptive to working towards the sustainable development of their industry?"

Generally, construction industry stakeholders interviewed in the context of this research were receptive to very receptive to discussions on sustainability and adopting sustainable practices in the development of their industry. Concurrently, the same respondents expressed their reservations by discussing some of the barriers to adopting sustainable practices in the Ghanaian context.

There is a recognition that action needs to be taken to care for the environment and the effects of the industry's activities on Ghana's ecology. The Ghana Real Estate Developers Association (GREDA) represents the traditional construction industry. The Mission & Vision Statement of GREDA mentions nothing about ecological sustainability, nor did the Executive Director of GREDA mention ecological sustainability as an objective during the interview process. The Director and the Mission Statement both, however, mention adequate quality and affordable housing for all classes of the population, a nod to the socio-economic aspect of sustainability (Amegayibor 2014). The Director also mentioned during the interview that the industry is becoming increasingly aware of the need for sustainable development, and the level of concern is rising. "We as developers need to be more conscious of the environment. It is now a concern to all of us. We are looking for other ways and means for ensuring that we minimise our environmental impact" (Amegayibor 2014).

The Mission Statement of the Ghana Green Building Council (GBC), the arm of the construction industry dedicated to building sustainably, is much more direct in its commitment to sustainable development, stating that they are dedicated "to transforming the built environment in Ghana towards sustainability through the way our communities are planned, designed, constructed, maintained and operated" (GHC Handbook 2011, 11). The Executive Director of the GHGBC reiterated the GBC's commitment during the interview process, specifically stating that the purpose of the GHGBC is sustainable construction (Osae-Akonnor 2014).

Representatives from the architectural sector are concerned that the construction industry has a substantial impact on the environment and traffic congestion (Amoako 2014), loss of agricultural land to construction (Atongo 2014) and changing weather patterns causing flooding and other damage (Atongo 2014). The architectural industry is slowly becoming more aware and more concerned about the sustainability challenge (Amoako 2014; Atongo 2014). The architect Amoako who was interviewed, touched on the need for institutional

change within the industry in regards to knowledge on the local environment. In his responses, he claimed that the knowledge about sustainable construction in the country in general is very limited.

One environmental concern that is very pertinent to Ghana's construction industry and that was alluded to in many of the interviews is the industry's reliance on timber and the effect of its harvesting on the nation's biodiversity. Currently, nothing that is produced from timber is reused or recycled, adding to the harmful life-cycle of this resource (Amoako 2014).

Bukari Braimah (2014) and Commey (2014), representing the NGO sector, are personally connected to both ecological and social issues, and responded that the NGO sector at large is very concerned about the sustainability challenge in Ghana. They reported that there are a number of NGOs working diligently towards sustainability across all sectors in Ghana. They are particularly active in proposing measures to hold both the government and the business communities accountable to keeping their commitments to protect the environment.

Ahmed (2014) and Ameyedor (2014), representing the general public's attitude towards sustainability, mirror sentiments from the other sectors that the level of knowledge and concern about sustainability is rising, with greater attention being given to sustainability measures. Ameyedor (2014) mentioned prioritization as a key theme – that the government, with its many competing needs and challenges, should give greater priority to education (including sustainability) than to other needs like health care and infrastructure.

Typically, Ghanaian contractors and stakeholders are afraid to take the risk of being innovative (Amoako 2014; Amegayibor and Adjiri 2014). For instance, Amoako who is an architect, shared that when he recommended a slate roof to a client, the client quickly refused because this was a new technology and was more expensive upfront, even though it would be cheaper in the long term. This type of reaction seems to be common and is a barrier to the long-term adoption of sustainable practices in an industry that is weary of change and unwilling to conform to technological innovation.

A main barrier to sustainable practices within the construction industry that was repeatedly mentioned in the interviews is the lack of enforcement of existing building codes. To describe their current state, Amoako said that they "are not up to date; they are very old and have not been edited since the colonial days." He added that even though the engineering department within the Ministry of Works and Housing is responsible for the building codes, they are not well defined or well enforced (Amoako 2014). Amegayibor and Adjiri (2014) expressed that a possible solution is to revise the building codes and allow for more incentives that will lessen the costs of construction and encourage developers to build sustainably. On a similar note, Atongo (2014), who is also an architect, mentioned that there is a need for government to provide adequate economic incentives to enable contractors to build high-rise buildings and mitigate horizontal building development, which is currently destroying much of the remaining land.

Land title registration was another issue that was cited as a main barrier to sustainability and one that is very common in Ghana. Amegayibor (2014) and Adjiri (2014) explained that there are serious land title disputes between many developers and other stakeholders. Amoako acknowledged that there are many land litigation cases in the industry, and this is due to the owners selling the same property to multiple buyers. Therefore, a real estate or individual developer has to pay for the same piece of land at 2 to 3 times its original value. Amegayibor and Adjiri further mentioned that developers struggle to find land because of

cost limitations and problems of proving land ownership. The process of acquiring land title is often time consuming, delaying the entire construction process and diverting both time and money away from sustainability measures. Interviewees further proposed that government intervention is the only solution to changing the current system.

An interviewee representing the Environmental Protection Agency, Benefor (2014), expressed that government is undertaking a number of policy reforms and initiatives to integrate sustainable development in construction. Reinforcing the notion of outdated policies though, he talked about the numerous policies the government signed in committing to the country's sustainable development. These policies include the National Planning Commission (Shared Road Plan), Renewable Energy Law, Part of U.N. Sustainable Energy Plan, and C4 Initiative Action Plan-partnership with China to provide financing packages to Ghana. Their effects, however, are still not felt. His conclusion is that the problem is lack of resources or political commitment rather than of awareness of the sustainability challenge.

In addition to government, the role of business in addressing the sustainability challenge was another issue widely discussed by the interviewees. Amegayibor and Adjiri shared the thought that businesses-developers contribute drastically to the sustainability challenge and should take initiatives toward curbing them. Atongo and Benefor believed that it is the responsibility of both entities to tackle the challenge. For example, Benefor talked about public-private partnership and their capacity to provide innovative solutions to integrate efforts and know-how of government and business towards sustainability. He emphasised that this will create a shared experience platform where business can share their knowledge (e.g. cost saving) and government their influence and experience.

In addition to business and government, two other factors were thoroughly discussed, notably economy and financing. Most of the responses from the interviews point to the fact that in Ghana, there is a direct relationship between the economy and construction, as every time the economy weakens, construction activities consequently decrease (Amegayibor 2014, Adjiri 2014, Atongo 2014, Amoako 2014). According to Atongo, the government plays a pivotal role here as it directly influences the economy, which affects job creation that then leads to increasing demand for housing and construction. Similarly, Amegayibor and Adjiri claimed that improving the construction industry creates jobs and sales of related goods and services (like home improvement and consumer goods) that lead to an improved economy. Lastly, Amoako stated that increasing foreign investments have helped in keeping the building construction industry vibrant when the country is facing economic challenges.

Moreover construction projects are often stalled because of financing issues. This has been a huge impediment to successful completion of projects (Amoako 2014). From the analysis of an individual contractor and architect, Atongo mentioned that financing construction projects presents a great challenge in the industry. Amegayibor (2014) and Adjiri (2014) further added that financing from government is usually too bureaucratic, which stalls construction projects and reduces capital necessary to fund sustainability investments into a development.

4.2 Research Question 2

"Could sustainability oriented tools and processes help facilitate the transition towards the adoption of sustainable practices within the construction industry?"

Research findings show that the process of multi-stakeholder dialogues could be beneficial in helping design the improved GS tool, and that together could form part of a strategy to move the industry towards sustainability.

4.2.1 The Tool

Overview

The Matrix was discussed with the Executive Director of the Ghana Green Building Council. The Executive Director, Foster Osai-Akonnor, was chosen to discuss the Matrix because he is the chairperson of the GHGBC technical team that is developing the GS GH-v1 Tool and thus has the most knowledge about the G.S. Tool. He also has authority to incorporate the concepts of the Matrix into the proposed GS GH-v1 Tool. Only a sampling of the cells was reviewed due to time constraints during the interview process. It is left to the technical team responsible for implementing the Tool to review the entire Matrix and potentially for other industry stakeholders to also contribute their views on its content.

In general, the Executive Director agreed with the rationale and concepts of the Matrix and with the notion that it could help improve the existing Tool. The proposal is timely and relevant in that the technical team is currently in the process of developing the GS Tool for Ghana – a time consuming and challenging process that is of high priority to Osai-Akonnor. He concurred that the technical team could use the Matrix in the development process. He also concurred that listing the templates of the TSPD alongside the credits of the Tool is helpful, for example, by establishing linkages and relationships among various credits and actions. Such linkages can help users of the Tool better understand the rationales behind the credits and help them make more informed decisions.

Recommendations

The Point of Influence column was of particular interest to Osai-Akonnor. Points of Influence are those who have the authority to implement a change. By understanding who has the authority to implement change, stakeholders (in a multi-stakeholder dialogue process) can best formulate their operating strategy. An example the Director gave was the lack of recycled steel in Ghana. Currently contractors must choose between purchasing recycled steel from abroad or purchasing virgin steel available locally. The ideal would be if recycled steel were available locally. The Point of Influence column focuses the industry's attention on who would have the authority to make such steel available – for example, if the government were to authorize tax incentives for recycling steel to local manufacturers.

The Director recommended separating the Point of Influence column into two columns: Advocate for Change and Point of Influence (discussed further in Discussion below). Advocates for Change are the individuals or organizations who desire and initiate change (e.g., of policies, business practices, regulatory procedures, sources of building materials and energy, etc.), as distinct from those with the authority to implement the change. The addition of this column provides a strategic opportunity for the MSD process to identify who should initiate the process towards change.

Opportunities

Osai-Akonnor pointed out a number of barriers to sustainability that the Matrix could address. The first barrier is the lack of awareness of critical sustainability issues, and a lack

of information needed to address the issues, often resulting in general misconceptions. There is a general belief in the industry, for example, that building sustainably costs more. The Executive Director strongly disagrees with this attitude, acknowledging that upfront costs may be more, but the costs over the useful life of the material are less. The templates of the TSPD, taking future trends and product concepts into consideration, could help educate the industry as to the actual cost savings of sustainability-conscious products.

Second, there is a lack of concern about certain sustainability issues. Two particular concerns were mentioned: the profligate use of timber during the construction process (highlighted in the Materials Category of the Matrix), and the refusal to install rain harvesting systems (in the Water Category).

The third barrier towards sustainability is unenforced or complete lack of laws and regulations. The Executive Director mentioned several examples of this, including EPA's failure to enforce emissions standards, and the building department's failure to follow up on building codes and permits. Other interviewees confirmed these examples. The representative at the EPA confirmed EPA's lack of resources as one reason for failure to enforce certain regulations. He also mentioned that there are too many exclusions awarded to contractors, relieving contractors from compliance of certain regulations. The alignment of the respective credits to the Challenges and Points of Influence columns readily illustrates the linkages among the credits and challenges.

Similarly, some policies are too vague to be adequately complied with by the industry. The Director referred to the Reclaimed Contaminated Land credit as an example where there is no adequate definition of "Contaminated." This issue will increase in importance as more former industrial space is converted to residential housing, as is occurring today.

Ambiguity of language is another barrier to sustainable construction. Ambiguous terminology may mask an accurate understanding of a challenge. The Director took special exception to a perception in the industry that water is 'scarce.' The Director maintains that the issue is not lack of water, but rather lack of access to water – a difference with significant implications for policy-making. By understanding that the problem is access, not shortage, the government can more accurately form incentives programs – for example, for new technology to access water rather than conservation programs. The Director also explained that an area of particular concern is Ghana's dependence on one major source of water – rivers flowing from neighboring Nigeria. Such dependence is problematic for Ghana – a concern made evident by the future Market Needs and Product Concepts templates.

Aligning the Energy credit with Product Concepts emphasizes the importance of technology in solving the energy issue. The Director mentioned that innovative day lighting equipment, for example, could be installed to reduce heat build-up generated by direct solar radiation, thus reducing the need for air conditioning units in the building.

Caveats

There are also limitations to the effective use of the Matrix. The Director mentioned several caveats of using the Matrix.

First, the technical team, in conjunction with representative stakeholders, should populate the individual cells because the team is most knowledgeable about the industry and local

environment. This provides an opportunity for multi-stakeholder dialogue, as discussed in the Discussion section below.

Secondly, the technical team should assign the weightings to the individual credits. Such weightings require in-depth on-the-ground knowledge of the physical, political, economic and cultural landscape in Ghana.

The Director voiced concern over who should be the Advocator of Change in moving towards sustainability. He disagreed with who should initiate particular actions, stating that someone must initiate an action before the MSD process can commence, and that sometimes there is disagreement as to who the initiator should be.

4.2.2 The Multi-Stakeholder Dialogue Process

Every stakeholder interviewed stated that multi-stakeholder dialogues could be an applicable process to discuss sustainability within the Ghanaian construction industry. Amoako (2014) said in his interview that MSD is likely to work in Ghana because many of the stakeholders are aware of the sustainability challenges in the industry and are willing to find solutions to them. Amegayibor (2014) also asserted that this process could be a suitable effort to incite stakeholders to engage in sustainable practices in the industry.

According to Osae-Akonnor (2014), the process of MSD has been utilised in the past to achieve common consensus among stakeholder, yet there is no information on them or evidence that they were either successful or not. He was in general more sceptical about adopting this process than other stakeholders.

Atongo (2014) also expressed hesitation, stating that it would be possible, but would nevertheless be difficult to implement in the context of the industry. Though not an MSD process, Atongo cited an example of a public-private partnership that took place in Ghana's housing sector involving Korean and local stakeholders. He thinks an MSD process would be difficult because this particular project was stalled due to "board room wrangling."

There were differences in opinion amongst stakeholders over who should be the convener (initiator) of the MSD process, though they all emphasized the importance of this role. Amoako (2014) proposed that the town planners, an agency of the Ministry of Works and Housing, should be the ones to initiate it. GREDA representative Amegayibor and Adjiri (2014) indicated that the success of the process is mostly based on the convener, adding that it is ideal that the government is responsible for this role. They added that a similar process was started by GREDA 25 years ago by the government to develop housing as a public-private-partnership agreement; however they are not aware of how the project proceeded.

Though many of the interviewees pointed to the government as the likely convener, many of them also alluded to the government already doing all it can to lead change towards sustainability in the industry (Amoako 2014). Atongo (2014) shared the same thought and adds that this is "because there are not enough resources, and there are always competing needs for government." He further expressed that government is providing enough information to allow stakeholders to make sustainable decisions, emphasizing that "government needs to develop programs that every stakeholder can agree on and educate the public" and that "MSD must be done in collaboration with business and public."

Based on analysis of the research content and data findings from the conducted interviews, certain characteristics of the MSD process emerged. These characteristics are explicitly listed by Bukari Braimah (2014) and Commey (2014) who stated that for any multi-stakeholder dialogue to be effective, it must include the following:

1. Clear objective: The dialogue must have a clear objective;

2. Inclusion: All key stakeholders must be invited to participate in the discussion; stakeholders must not be excluded just because they hold different viewpoints;

3. Participation: Stakeholders must be allowed to fully participate in the discussion;

4. Transparency: All relevant information (including a full explanation of the strategic process) must be made available to all stakeholders. For MSD to work, equal access to information for all involved is absolutely essential;

5. Actively Involved Representative: One (or at least one) individual must agree to actively represent his/her industry;

6. Rapport/Trust: Participants must build rapport with one another and with the institutions they are trying to influence;

7. Accountability: Participants must be held accountable for their actions and responsibilities;

8. Common vocabulary: Participants must readily understand one another's industry jargon;

9. Capacity and resources: Participants must be capable of performing the tasks they have agreed to undertake;

10. Organizational capacity: Process must include managerial actions like producing agendas, timelines, meeting minutes, etc.

5 Discussion

The above analysis has shown that the construction industry significantly impacts the ecological and social environment and thus warrants in-depth study. The industry consumes huge amounts of global resources because of the resource intensive nature of its activities. Nevertheless, this resource dependency could be mitigated if the industry adopts sustainable practices discussed and agreed upon by all relevant stakeholders, fully transparent of the implications for the industry, the built environment and the country at large.

The knowledge and technologies needed to produce sustainable buildings are purportedly available and the economic benefits of sustainable design and construction are now well documented in more industrialized country context literature. However, construction industries continue to be unsustainable, with incentive discrepancies among the industry's numerous stakeholders. To achieve sustainable development, there is a need to identify the appropriate values and ideological concepts to increase knowledge on behavior, interaction, and factors and improve relationships in the economic, social and political context.

5.1 Stakeholder Receptivity & Openness to Sustainability

This All of the individuals interviewed indicated receptiveness to making the construction industry sustainable. Differences of opinion on this question were dependent on the degree of receptiveness, reliant primarily on the stakeholder sector (business, government, NGO, etc.).

The literature review indicated certain specific challenges preventing the construction industry from moving towards sustainability as discussed previously. It was anticipated that the Matrix could highlight some of these challenges. It was also anticipated that the concise formatting of the challenges aligned with the credits and the templates of the TSPD could provide a quick overview of the nature of the challenges facing the industry – a key benefit of the TSPD. Subject to some caveats and clarifications the interview with the Executive Director confirmed these expectations.

Barriers to change, as cited in the literature (Djokoto 2014) and confirmed in the research process, highlighted the need for addressing the sustainability challenge. The GHGBC interview in particular reiterated that lack of awareness of issues, vague, missing or unenforced regulations, ambiguity of language, and lack of resources, all of which contribute to the need for the industry to assess the challenges and discuss solutions (Osae-Akonnor 2014).

Because stakeholder involvement is an important feature of the TSPD, the Tool, as informed by the TSPD, works well in combination with the MSD process. The Matrix is designed to address the barriers to sustainable construction as identified in both the literature and interview process. Lack of awareness and lack of legislation (or enforcement of existing legislation) are two barriers frequently mentioned in the literature. Our research indicates an ambiguity in the level of awareness in the industry, by government officials, and by the general public. While some responses indicate there is a lack of awareness about the sustainability challenge (Djokoto 2014), others responded that the problem is not ignorance but rather apathy, lack of resources to act, political infighting, or lack of prioritization of the problem (Braune n.d.; Benefor 2014). Further research is needed to clearly understand the

level of awareness of the sustainability challenge. At the very least, the Matrix helps explain the sustainability problem and offers a step in a path towards sustainable actions.

Two further points must be considered about Research Question One: (i) the word 'receptive' is subjective, requiring clarification; and (ii) 'sustainability' has not been clearly defined across all sectors.

None of the stakeholders interviewed definitively stated that their respective sectors are not receptive to sustainability and all indicated that they are open to discussing it. However, they are only representative of their respective industries and it would require further study to determine to what extent their industries, as a whole, would be receptive. For purposes of this study, it is assumed that the industry as a whole is receptive to discussing sustainability. While all interviewees stated that sustainability is important and relevant, none of the interviewees made any commitments to become sustainable or to engage in certain actions. Receptivity was limited to 'consideration', rather than commitment. Receptivity also depends on the level of *awareness* of the issue of sustainability. It can be argued that true receptivity is not possible, or is not meaningful, if stakeholders are not fully educated about the issue. Lack of awareness could severely limit concern about, and thus receptivity to, sustainability. And vice versa, more awareness could increase receptivity. This, too, requires further study.

Interviewees remained divided as to the severity of the sustainability challenge, what its causes and implications are, who may bear the responsibility to address it, or how long it may take and what type of resources should be committed to fighting it. Consequently, no levels of prioritization were assigned to these items. Thus 'receptive to addressing it' could range from slight curiosity to outright full commitment of all available resources. Only further study could determine the precise level of commitment of actors.

The term 'sustainable' has also not been mutually agreed upon across sectors. For purposes of this study, 'sustainability' has been defined as construction practices that protect the physical environment and social well-being of the local community. This definition, however, has not been tested with all stakeholders and may be subject to sector and personality specific interpretation. Different stakeholders have different values, perspectives, vested interests, and levels of expectations. What may be 'sustainable' to one sector may not be sustainable at all to another. This is an element that must be refined by further study. These unilateral understandings of definitions could be, and probably should be, a primary task of the multi-stakeholder dialogue process, as part of the Clarification of Objective of the MSD process.

5.2 The Matrix & the Multi-Stakeholder Dialogue Process

This research indicated that the Matrix and multi-stakeholder dialogue could be effective in helping move the industry towards sustainability. With some limitations and fine-tuning to the local Ghanaian context, the Matrix and MSD can help identify and address the challenges facing the construction industry and provide a strategic methodology to guide the industry in its planning and actions.

In a broader sense the strategic design of the Matrix can help the industry address sustainability challenges in a number of procedural ways. GHGBC director Osae-Akonnor, agreed, for example, that by taking emerging needs and trends into account, the industry can

better anticipate sustainability issues not yet a problem, but destined to become a problem if not addressed. Energy, water and materials used in construction, for example, are available now, but may not be in the future if the construction practices do not adapt.

The design of the Matrix illustrates the complex nature of the industry and shows the benefits of approaching the challenges in a strategic way. MSD is a particularly suitable method for addressing the complex nature of the problems. The Matrix also prompts users of the Matrix (including participants in MSD discussions who may use the Matrix) to ask probing questions brought to light by the Matrix. For example, Osae-Akonnor mentioned that the real challenge related to water was not scarcity but access, as mentioned above. By asking the users to identify the appropriate Point of Influence, users are prompted to consider what the real nature of the issue is, what the policy should be, and how to structure their strategy.

Furthermore, the Matrix strategically guides users' actions, clearly identifying challenges and connecting them to potential solutions. For example, the GHGBC director referred to the problem of disposal of waste from a construction site. The issue is both one of lack of concern by contractors (largely because waste disposal sites are not yet a problem), and lack of awareness of the need to recycle (both a construction industry and general public issue). Here the templates highlighting future problems are of special interest. The Matrix's aligning the credits, challenges and emerging trends of waste management allows the industry to discuss solutions in a strategic manner. This is also an area where MSD can be of particular benefit, given the complexity and multi-dimensional nature of the problem.

It is worth noting that Osae-Akonnor agreed that the proposal to inform the GS Building Rating Tool in Ghana is timely and relevant in that the GHGBC technical team is in the process of developing the Tool for Ghana. Because the TSPD is intended for products (including services and processes) at an early development stage, the TSPD is an appropriate framework to apply to the GS Tool development.

The Matrix illustrates ambiguity of language (e.g., 'access to' versus 'scarcity of' water), the importance of emerging technologies (e.g., falling prices of alternative energy sources as supplies increase) and the lack of concern and demand for sustainable construction by property owners. By aligning credits with barriers and Points of Influence, relationships among credits, challenges and stakeholders become apparent and offer possibilities for addressing the barriers. For example, the Matrix links alternative energy technology to policies needed to incentivize adoption of such technology. Such linkage allows users of the Matrix to probe the question "Who has the authority to enable or block policies that could benefit alternative energy?" The probing of questions allows a brainstorming of solutions and potential strategies.

The combination of the Matrix and MSD offers a strategic approach towards sustainability. The process includes defining the scope of the industry, drafting a clear description of the problem, understanding goals, principles, resources and vested interests of all stakeholders, brainstorming options to achieve the goals of the respective stakeholders, prioritizing the options, designing an action plan to implement the plan and setting up an administrative entity to manage the details of the plan.

Drafting a clear definition of the problem is crucial to defining the vision and the actions of the stakeholders. It is insufficient to define the problem as "contributing to ecological and social unsustainability." That definition is not clear enough to drive action and instead, discourages stakeholders and limits their ambitions and efforts towards action. Given the

vast and complex nature of the construction industry, analysis must be dissected into smaller, manageable pieces that can be targeted individually. The Matrix facilitates this by focusing attention on the credits one by one and their respective challenges and systematic points of influence. Stakeholders can strategically and methodically examine each credit and brainstorm actions that can address the challenges of each credit.

Understanding the various goals and vested interests of each stakeholder is also crucial to the process. While stating an all-encompassing vision such as "creating a healthier and more equitable environment for all residents of Ghana" is a step in the right direction, it is not very useful to the process. To be truly effective, the process must organically understand stakeholders' positions and attitudes credit by credit. It is truly a collaborative, and sometimes combative, process. The process may require compromise to achieve overall consensus.

The Matrix probes the impacts of decisions and the relationship among credits and stakeholders. Such relationships help guide brainstorming for decisions, benefits and challenges of choices, and criteria by which to make those decisions. The industry has limited resources in terms of financial and political capital, skills, labor and time. Not all actions can be undertaken on a given project. Some actions, such as meeting demand for low-rise single-family homes versus more sustainable 'vertical' high rise development, may be, or appear to be, mutually exclusive. The Matrix helps the industry in weighing options and making decisions.

MSD can then provide the process by which stakeholders discuss the options. Once alternatives are identified and priorities assigned, the stakeholders can strategically discuss recommended actions, the tools and resources necessary to implement the plans, as well as an execution plan. Again, breaking the overall desire to 'build sustainably' into smaller pieces can help focus strategy and imagine realistic and effective actions.

A basic component of planning for action is responsibility and accountability – assigning actions to those with the skills and resources to achieve the desired outcome and holding them accountable for their commitments. The Matrix guides the industry in understanding who may be best suited to advocate for change (e.g., in policy or ways of doing business) and who has the authority to implement the change. The importance of this function became evident in interviews when different responses were shared to the question, "Whose responsibility is it to lead the industry towards sustainability?" Though the general consensus was that it is the government's responsibility to initiate and lead the process, all sectors have a certain degree of responsibility, including "the developed world, since they caused the problem" (Benefor 2014). By including Advocates of Change and Points of Influence in the Matrix, users of the Matrix are required to consider and discuss who has responsibility for making change. MSD is ideal for this conversation.

It is important to understand who has the resources to contribute towards sustainability. Universities and research labs, for example, can contribute technical information. The business community can contribute financial capital, physical products and services. NGOs can represent the voice of the general public, and the environment itself. Lastly, the government can supply the political, legal and logistical policies and framework required. In terms of the Matrix, the Advocate for Change and Points of Influence columns clearly delineate roles and responsibilities and the challenges, needs and opportunities confronting them.

A review of the Advocates for Change and Points of Influence can help identify stakeholders who should be part of the process. Those who can benefit by change are often the ones who can or should lead the move towards change. Solar energy companies, for example, should lobby the government for incentives for solar power. Recycling companies should lobby for recycling incentives and education. Bicycle coalitions should lobby for bike lanes and alternative transportation. Each sector leading the actions towards change in their respective arenas can result in a holistic and lasting solution.

Many actions, of course, require cross-sector collaboration. Recycling, for example, requires an education campaign for the industry to understand the importance of recycling and a follow-up campaign for how to use the systems and products made available to them. A growing phenomenon of multi-party partnerships and collaborations is emerging to share resources and support one another in their respective actions.

Several of the stakeholders interviewed emphasized the importance of the convener (initiator of a planning process) as crucial to a successful multi-stakeholder dialogue planning process (Atongo 2014; Amoako 2014). The convener sets the tone of the process, provides organizational and administrative services, and is widely responsible for identifying and inviting the stakeholders who should be involved in the process. The convener often defines the general vision towards sustainability; individual stakeholders then contribute their respective visions until a group vision is formed. Thus, the convener sets the direction. In Ghana, it is anticipated that the Green Building Council will be the initiator of the process, with the Matrix as the guiding document and multi-stakeholder dialogue as the planning process. While the GBC has the ultimate authority over the final GS Tool document, using multi-party input into the design process, the new GS Ghana Tool can incorporate the values, vested interests and visions of the respective participants in the process.

Some limitations about the Matrix and MSD process emerged from the interviews. The Executive Director of the GHGBC warned that the Matrix should be populated by the industry itself, since they know best the local context of the community in which the construction will take place. The existing GS SA-GH v1 Tool and the proposed GS GH-v1 Tool need to be customized to the Ghanaian context. The framework of the Matrix is sturdy enough to guide the industry, yet flexible enough to allow for local contextualization. Some actions will need pre-actions to prepare the industry or other stakeholders for the required actions. For example, providing recycling containers on construction sites is useless if the contractors do not know how to use them. All phases, from inception to completion, of the desired actions must be considered.

In order for this to occur within an MSD process, the barriers and challenges of MSD need to be addressed, including: finding the right participants, managing extremely limited financial resources, providing effective meeting facilitation, capturing and keeping the attention of participants and establishing trust amongst them. Susskind (2013) claims that "too many multi-stakeholder dialogues flounder because the participants are inadequately prepared, the processes are managed ineffectively, and expectations are unrealistic."

If the construction industry does adopt the MSD process, an initial scoping exercise is required to ensure there are sufficient time, resources, and commitment to begin the process. Additionally, the following actions should be considered to help engage the MSD process:

- work with stakeholders from the very initial stages in order to ensure equal levels of ownership over the process; this is why involving stakeholders in the design of the GH-v1 Tool is imperative;
- identify a core coordinating group to manage the process that will need to have a good understanding of the issues under consideration, have good contacts across a range of sectors and have a well-founded understanding of multi-stakeholder processes at large; including representatives like architects, contractors, government officials and community organizers would be beneficial;
- locate the issues to be addressed and approach the possible facilitators;
- identify clear timelines and milestones ensuring adequate time for preparation.

The legitimacy and credibility of processes and participants depends on the competence and expertise of the actors involved; thus equitable access to information and capacity building, where necessary, should be provided to ensure competence on all sides.

Separating Advocates for Change and Points of Influence should technically be included in the Extended Enterprise columns of the Matrix, as they are themselves stakeholders. They are separated from the Extended Enterprise columns in that they deserve special attention given the crucial role they play in the strategic process towards sustainability. It is feared that their relevance and importance could be lost if submerged in the multiplicity of stakeholders in the Extended Enterprise template of the TSPD.

The role of stakeholder engagement is to help articulate a common need, promote a shared vision, overcome barriers and bridge silos between parties. Based on the analysis of the collected data, the need to identify stakeholders and engage them in the Tool related dialogue, and the identification of the Points of Influence throughout the construction industry, there are ten suggested ways the MSD can help in the process of moving the industry from its current state to one that takes sustainability into account:

1. Identify stakeholders
2. Clearly define the Problem
3. Define core values and principles
4. Brainstorm for solutions
5. Devise a strategy to move towards the solution
6. Contribute the capacity and resources towards a solution that everyone can live with
7. Hold everyone accountable to their commitments
8. Ensure a transparent process, making sure everyone has equal access to all information
9. Design a process that builds trust and rapport among all SHs
10. Provide a common language to maximize clear communication among all participants.

By and large, interview findings indicate that it is possible for different stakeholders in the construction industry to agree upon a common vision as to how environmental problems, and

the industry's contribution to them, should be addressed. It was affirmed through these same interviews and survey results that industry professionals would be willing, and even eager, to participate in such a dialogue. "The process could work because professionals (building contractors, town planners, architects, engineers, surveyors) are all aware of the problem, want a solution and can work together" said GREDA Executive Director Amegayibor (2014).

"When all stakeholders collaborate in designing their collective future, it increases the chances of former differences being resolved and a new consensus emerging around issues everyone can agree on" (The World Bank Participation Sourcebook 1996, 135).

5.3 Further Research

The areas for further research include:

1. How much of the industry is concerned about the sustainability challenge?
2. What is the level of awareness within the construction industry about the sustainability challenge?
3. Who does the industry believe should initiate a move towards sustainability?
4. Who does the industry believe is responsible for implementing the changes necessary to become sustainable?

5.4 Implications

If an MSD process is initiated, strategically planned and successfully carried out over a specific period of time, the Ghanaian construction industry could serve as an example to other sectors within the country and to parallel industries in other benchmark nations. Most importantly, if the industry stakeholders succeed in collaborating and joining efforts, their expertise and commitment to improving the current state of their sector will have wide-reaching effects on the country's built environment and, consequently, the overall state of Ghana.

5.5 Limitations

Time restrictions and direct access to the relevant stakeholders were the principal limitations to this research. More time could have allowed for more extensive research on the current state of the construction industry in Ghana, paying particularly attention to local perceptions of multi-stakeholder dialogues. As the local context favors face-to-face meetings, as opposed to Internet-based communication (often because of unreliable Internet access while using platforms such as Skype), the limited the number of interviewees could be only be augmented by more time in the country.

6 Conclusion

The current practices of the construction industry in Ghana contribute to ecological and social conditions that are not sustainable; that is, if continued at the current or at an accelerated rate, will create stresses on the environment and on social conditions that will exacerbate the sustainability challenge.

In general the research undertaken by this paper verified that the construction industry in Ghana is open and receptive to becoming sustainable, and that the Green Star Building Rating Tool, as informed by the Template for Sustainable Product Development, in combination with a multi-stakeholder dialogue process, could help move the industry towards greater sustainability.

The research indicated that sustainable development is relevant and important to the industry. Ecological and social challenges are mounting in Ghana as the pace of construction accelerates to keep up with rising demand for commercial and residential buildings. The industry is becoming increasingly aware of the sustainability challenge in general, and the construction industry's contribution to it. The industry is also learning that the sustainability challenge is not only bad for the environment and society; it's also bad for business.

Once it was determined that the industry is open to becoming sustainable, further questions proceeded: What would be a strategic methodology the industry could follow to become sustainable? Could the building rating tool under consideration in Ghana be improved to better guide the industry towards sustainability? And what process could the industry follow to assist stakeholders in their efforts?

Changing long-standing ways of doing business is not an easy task. Material sourcing, supply chains, business relationships, and skills and knowledge about day-to-day business practices all must be reviewed with an eye towards sustainability. Exerting the effort to solve the sustainability challenge itself is a significant task. Breaking the large challenge into small, manageable parts could be an effective means to ending part of the inertia and lack of in-depth knowledge gripping the industry and to initiating the process towards sustainable construction.

The GS Building Rating Tool as informed by the TSPD (in a form called the Matrix), in combination with multi-stakeholder dialogue, was proposed to the construction industry in Ghana. The industry agreed that the Matrix-MSD combination could be an effective combination, with some caveats. It is not an easy process, as reiterated throughout this research paper, as stakeholder attitudes require shifting and future actions require strategy.

If stakeholders decide to undertake the actions necessary to move towards sustainability, and to initiate and plan the process, then they would need a strategic approach to do so. The problem would need to be clearly identified, a common vision declared, and a plan of action undertaken. Participants would have to be held accountable for their commitments and an administrative entity (administering to the managerial functions of the process) put in place. The industry has indicated it is receptive to becoming sustainable. The question that ensues that will determine if and how the construction industry in Ghana can become sustainable is "Are industry stakeholders prepared to do the work necessary to strategically move towards sustainability?"

There are many implications of the results of this research. First, the Matrix and the MSD process could each contribute towards sustainability, even if undertaken individually and separately. The two should be used in combination, however, to maximize their impact. There is a symbiotic relationship between the Tool and multi-stakeholder dialogue. The TSPD recommends multi-stakeholder involvement in the process. MSD needs a structure to guide the process. The two working in harmony could produce a powerful result. The Matrix-MSD combination can assist the GHGBC technical team in designing the proposed GS GH-v1 Tool, guiding the industry in using the Tool and incorporating its guidelines into their daily business. The Matrix-MSD combination can also assist in guiding the industry during their MSD planning process.

The construction industry is a complex industry with a wide range of ecological and social impacts that also affects multiple stakeholders. The implications of successfully making the transition to sustainable construction are vast, affecting life in Ghana for generations to come. Research findings from this paper indicate that proper planning, consisting of the appropriate tools and processes, can help address the sustainability challenge. Ongoing research will be needed to determine if in fact the industry adopts the necessary tools and processes and undertakes the actions needed to become sustainable and what further actions need to be taken to ensure this happens

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Appendices

Appendix I: Sampling of Building Rating Systems Worldwide

RATING SYSTEM, RATING ORGANIZATION	REGION	PURPOSE
Building Environment Assessment Method BEAM Society	Hong Kong	To provide comprehensive building performance ratings
Building Research Environment Assessment Method Consultancy (BREEAM) BRE Trust	U.K. Northern Europe	To advance knowledge, innovation and communication for public benefit
City Energy Project Model NRDC and Market Transformation	U.S.A. cities	To create healthier, more prosperous cities
Comprehensive Assessment System for Japan GreenBuild Council and Japan Sustainable Building Consortium	Japan	To assess and rate the environmental performance of buildings and the built environment
Energy Star U.S. Environmental Protection Agency	U.S.A.	Voluntary program to identify and promote energy efficient products and buildings
Green Globe Rating System Global Reporting Initiative (GRI)	worldwide	To promote the use of sustainability reporting as a way for organizations to become more sustainable and contribute to sustainable development
Green Rating for Integrated Habitat Assessment The Energy and Resources Institute	India	To bring down the ecological impact of buildings in India to a nationwide acceptable level
Green Star Building Rating System Green Building Council- Australia	Australia, South Africa, Ghana	To evaluate the environmental design and construction of Buildings and communities
Leader in Energy and Environmental Design (LEED) U.S. Green Building Council	Primarily North America	To help building owners and operators to be environmentally responsible and use resources efficiently
Living Building Challenge International Living Future Institute	Worldwide	To be the world's most rigorous design standard
Minergie Minergie Association	Switzerland	To construct compact, well-insulated and air-tight buildings in order to attain good energy consumption standards
National Home Energy Rating Scheme National Energy Services (NES)	U.K.	To promote energy conservation and renewable energy
Pearl Rating System Abu Dhabi Urban Planning Council	Abu Dhabi	To promote the development of sustainable buildings and improve the quality of life
Sustainable Building Challenge Framework International Initiative for Sustainable uilding (iiSBE)	worldwide	To actively facilitate and promote the adoption of policies, methods and tools to accelerate the movement towards a global sustainable built environment

Appendix II: The Existing Green Star Building Rating Tool

	CATEGORY, CREDITS
	MANAGEMENT
Man 1	Green Star Accredited Professional
Man 2	Commissioning Clause
Man 3	Building Tuning
Man 4	Independent Commissioning Agent
Man 5	Building Users Guide
Man 6	Environmental Management
Man 7	Waste Management
Man 8	Air Tightness Testing
	INDOOR ENVIRONMENTAL QUALITY
IEQ 1	Ventilation Rates
IEQ 2	Air Change Effectiveness
IEQ 3	Carbon Dioxide Monitoring & Control
IEQ 4	Day Light
IEQ 5	Day Light Glare Control
IEQ 6	High Frequency Ballasts
IEQ 7	Electric Light Levels
IEQ 8	Electric Light Levels
IEQ 9	Thermal Controls
IEQ 10	Individual Comfort Control
IEQ 11	Hazardous Materials
IEQ 12	Internal Noise Level
IEQ 13	Volatile Organic Compounds
IEQ 14	Formaldehyde Minimization
IEQ 15	Mold Prevention
IEQ 16	Tenant Exhaust Risers
IEQ 17	Environmental Tobacco Smoke Avoidance
	ENERGY
Ene 0	Conditional Requirements
Ene 1	Green Gas Emissions
Ene 2	Sub-Metering
Ene 3	Lighting Power Densities
Ene 4	Lighting Zoning
Ene 5	Peak Energy Demand Reduction
	TRANSPORT
Tra 1	Provision of Car Parking - near public transportation
Tra 2	Provision of Car Parking - personal vehicles

Tra 3	Cyclist Facilities
Tra 4	Commuting Mass Transport
Tra 5	Local Connectivity

	WATER
Wat 1	Occupant Amenity Water
Wat 2	Water Meters
Wat 3	Landscape irrigation
Wat 4	Heat Rejection Water
Wat 5	Fire System Water Consumption
	MATERIALS
Mat 1	Recycling Waste Storage
Mat 2	Building Reuse
Mat 3	Reused Materials
Mat 4	Shell and Core and Integrated Fit-out
Mat 5	Concrete
Mat 6	Steel
Mat 7	PVC Minimization
Mat 8	Sustainable Timber
Mat 9	Design for Dissassembly (eg dissassembling roofs)
Mat 10	Dematerialization
Mat 11	Local Sourcing
	SUSTAINABLE SITE DEVELOPMENT
SSD 0	Conditional Requirements
SSD 1	Topsoil
SSD 2	Reuse of Land
SSD 3	Reclaimed Contaminated Land
SSD 4	Change of Ecological Value
	EMISSIONS
Emi 1	Refrigerants/Gaseous Ozone Depleting Potential
Emi 2	Refrigerants/Gaseous Warming Potential
Emi 3	Refrigerant Leaks
Emi 4	Insulant Ozone Depleting Potential
Emi 5	Watercourse Pollution
Emi 6	Discharge of Sewer
Emi 7	Light Pollution
Emi 8	Legionella
Emi 9	Boiler and Generator Emissions

Appendix III: The Traditional Template For Sustainable Product Development

I. Market Needs & Desires Current market desires addressed:	II. Product Concepts Current design of today's product:	III. Extended Enterprise Current stakeholder communication/cooperation:
What *current* market desires and needs is the product/service intended to meet?	What *current* flows and management routines from the life cycle of the chosen product/service concept are critical from a full sustainability perspective?	What *current* preferences and conditions of societal stakeholders are opposing the introduction of more sustainable product/service concepts?

(Ny 2009, 84)

I. Market Needs & Desires Likely future market desires to address:	II. Product Concepts Likely conceptual design of future product:	III. Extended Enterprise Likely future stakeholder communication/cooperation:
What *new* market desires and needs are likely to evolve in the future as responses to the sustainability challenge?	Could the physical flows, management routines, etc, related to the *current* life cycle of the product concept be developed to reduce the risk of societal violation of the basic sustainability principles?	What *future* societal stakeholder preferences and conditions would be particularly favorable for the development of more sustainable product/service concepts, and how could the company interact with external stakeholders to facilitate such changes?

(Ny 2009, 85)

Appendix IV: The Matrix - Challenges and Opportunities

CREDIT: MANAGEMENT	CHALLENGES AND OPPORTUNITIES
Green Star Accredited Professional	no GS-SA Accredited Professionals avail in Ghana
Commissioning Clause	lack of commissioning regulations and guidelines
Building Tuning	rare in Ghana
Independent Commissioning Agent	rare in Ghana; need to appoint a commissioning agent
Building Users Guide	No template in Ghana; will need to write one
Environmental Management	EPA's Environ Mgt Plan not enforced
Waste Management	no regs, few waste-mgt plans, little waste mgt.
Air Tightness Testing	no tests being done in Gh - not considered necessary

CREDIT: INDOOR AIR QUALITY	CHALLENGES AND OPPORTUNITIES
Ventilation Rates	no requirements for access to outside air
Air Change Effectiveness	rare - analysis not required
Carbon Dioxide Monitoring & Control	rare - not required
Daylight	modeling is rare even though required by bldg code
Daylight Glare Control	glare control modeling is rare
High Frequency Ballasts	typically excluded due to cost
Electric Light Levels	bldg code requires 'sufficient lighting' but does not say how much
External Views	typically done
Thermal Comfort	rare to model thermal comfort

Individual Comfort Control	rare to model individual comfort control
Hazardous Materials	professionals unaware of any stds or governing bodies EPA and Occup Health & Safety have haz. waste plans but unenforced nowhere in Gh to dispose of haz waste - must transport out of country asbestros is allowed in concrete manufacturing Workman's Comp Law of 1987 has some regulations
Internal Noise Level	professionals unaware of SANS reg; bldg code has regs but sound levels are unspecified
Volatile Organic Compounds (VOCs)	no stds and professionals are unaware of any products available products must be imported from abroad
Formaldehyde Minimization	professionals are unaware of dangers of formaldehyde
Mold Prevention	mold prevention measures are rare; ambigous as to whether required
Tenant Exhaust Riser	rare in Gh; unknown as to whether required
Environmental Tobacco Smoke Avoidance	rare in Gh; does not seem to be a prob since smoking is rare in Gh.

CREDIT: ENERGY	CHALLENGES AND OPPORTUNITIES
Conditional Requirements	Bldg Code and Energy Code have no requirements other than labeling. Modeling is rare. Modeling required by some funders. Netherlands Embassy is LEED certified, so compliance in Gh is possible protocols are available in Gh; will need to adjust the S.Afr benchmarks.
Greenhouse Gas Emissions	CO2 modeling is rare.
Sub-Metering	typical in office bldgs, but not for substantive, lighting or power use building mgt systems are available but rare
Lighting Power Densities	lower level stds are achievable and not that different from current stds.
Lighting Zoning	unusual but achievable
Peak Energy Demand Reduction	need is great in Gh due to frequent power outages; common practice unknown professionals unfamiliar with the term "load lopping"

CREDIT: TRANSPORT	CHALLENGES AND OPPORTUNITIES
Provision of Car Parking - near public transit	no strict requirement for car parking; rely on 'common sense' compliance
Provision of Car Parking - personal vehicles	to encourage use of energy-effic vehicle; rare but not difficult to implement
Cyclist Facilities	controversial - debate over number of bicyclists and need for roads and regs
Commuting Mass Transport	Gh uses 'tro tros' (vans); use expected to increase as congestion worsens

Local Connectivity	no specific requirements. Must be 'adequate'

CREDIT: WATER	CHALLENGES AND OPPORTUNITIES
Occupant Amenity Water	water is very big concern in Gh; regs unknown; no water labeling or certification system as in S.A. - recommended; water conservation systems like dual flush toilets and rain harvesting equip are available and should be std practice; no potable water category in rating system - recommend
Water Meters	separate water meters for tenants are standard but not for substantive use
Landscape Irrigation	water efficient irrigation systems are needed but rare; many bldgs depend on water trucks; no stds or regs appear to be in place; some bldgs have recycled water systems (like CFAO Motors Showroom and South Liberation Link)
Heat Rejection Water	cooling towers (eg tenant condenser water loops) are expensive and rare most bldgs rely on air based cooling.
Fire System Water Consumption	sprinklers in office bldgs are rare; more common in warehouses and dist. ctrs. unknown as to whether required by regs.

CREDIT: MATERIALS	CHALLENGES AND OPPORTUNITIES
Recycling Waste Storage	recycling is rare - few recycling bins or companies; Bldg Code requires space for refuse but not for recycling
Building Reuse	many bldgs are demolished to make way for new constr - big need to reuse
Reused Materials	reusing bldg materials is rare
Shell and Core and Integrated Fit-out	most space is built to suit; desirable to keep TI's to a minimum
Concrete	flyash and recycled aggregate are rare; contractors don't want to use concrete that is untested; limited number of concrete contractors in Gh - and those who exist do not use flyash or recycled aggregate
Steel	use of recycled steel is rare; but should be possible to import recycled steel
PVC Minimization	controversial - credits currently available, but under consideration.
Sustainable Timber	rare in Gh; many professionals unaware of the FSC, even though information is widely available about it, including from the Gh Min. of Trade and Industry
Design for Disassembly (eg disassembleable roofs)	technology and contractors are available; cost is higher
Dematerialization	difficult but achievable
Local Sourcing	highly recommended since most materials are imported; but rare and difficult

CREDIT: SUSTAINABLE SITE	CHALLENGES AND OPPORTUNITIES

DEVELOPMENT	
Conditional Requirements	recommend a mandatory Credit Interpretation Request for each project
Topsoil	recommend a mandatory Credit Interpretation Request for each project
Reuse of land	recommend building on reused land; recommend gov approves Urban Edges
Reclaimed Contaminated Land	no definition of contaminated; no contaminated sites are identified by local authorities; practitioners are required to conduct their own site assessments toolkits such as UNIDO Contaminated Site Investigation Tool are available
Change of Ecological Value	gov and EPA do not have charts of bio-regions in Ghana; practitioners need to evaluate ecological value of respective bioregion and then request a CIR

CREDIT: EMISSIONS	CHALLENGES AND OPPORTUNITIES
Refrigerants/Gaseous Ozone Depleting Potential	professionals are aware of the issue; tech is avail; no regs; used on case by case basis
Refrigerants/Gaseous Global Warming Potential	professionals are aware of the issue; tech is avail; rare in Ghana
Refrigerant Leaks	professionals are aware of the issue; not mandated; tech is avail; rarely installed
Insulant Ozone Depleting Potential	professionals are aware of the issue; not mandated; tech is avail; rarely installed
Watercourse Pollution	professionals are aware of the issue; rarely managed
Discharge of Sewer	professionals are aware of the issue; rarely managed
Light Pollution	achievable
Legionella	rely on cooling towers to control - rare in Ghana
Boiler and Generator Emissions	no stds or regs for emissions; Attorney General's office if reviewing proposed regs.

Appendix V: The Matrix - Market Needs and Desires

CREDIT: MANAGEMENT	CURRENT REALITY	FUTURE POSSIBILITIES
Green Star Accredited Professional	little need today	increasing need and availability
Commissioning Clause	little need today	increasing need and availability
Building Tuning	little need today	increasing need and availability
Independent Commissioning Agent	little need today	increasing need and availability
Building Users Guide	little need today	increasing need and availability
Environmental Management	regs not enforced	increasing enforcement
Waste Management	little consideration	increasing regulations
Air Tightness Testing	little consideration	Increasing regulations

CREDIT: INDOOR AIR QUALITY	CURRENT REALITY	FUTURE POSSIBILITIES
Ventilation Rates	need for fresh air	increased pollution
Air Change Effectiveness	need for fresh air	increased pollution
Carbon Dioxide Monitoring & Control	400ppm	600ppm
Daylight	need for sunshine	haze and soot
Daylight Glare Control	bright African sun	haze may reduce glare
High Frequency Ballasts	comfort levels of light	unpredictable electricity
Electric Light Levels	need for light	unpredictable electricity
External Views	comfortable work envir	may lose views with new construction
Thermal Comfort	comfortable work envir	increasing outside air temperatures
Individual Comfort Control	comfortable work envir	increasing outside air temperatures
Hazardous Materials	subsistence, protection	increasing toxicity
Internal Noise Level	comfortable work envir	increasing external noise level
Volatile Organic Compounds (VOCs)	subsistence, protection	increasing toxicity

Formaldehyde Minimization	subsistence, protection	increasing toxicity
Mold Prevention	subsistence, protection	increasing toxicity
Tenant Exhaust Riser	subsistence, protection	increasing toxicity
Environmental Tobacco Smoke Avoidance	subsistence, protection	increasing pollution

CREDIT: ENERGY	CURRENT REALITY	FUTURE POSSIBILITIES
Conditioning Requirement	hydroelectric, biomass	more natural gas, oil, biomass; less on hydro due to draughts
Greenhouse Gas Emissions	hydroelectric, biomass	natural gas, oil, biomass
Sub-Metering	hydroelectric, biomass	natural gas, oil, rising prices, biomass
Lighting Power Densities	hydroelectric, biomass	natural gas, oil, biomass
Lighting Zoning	hydroelectric, biomass	natural gas, oil, biomass
Peak Energy Demand Reduction	hydroelectric, biomass	natural gas, oil, biomass

CREDIT: TRANSPORT	CURRENT REALITY	FUTURE POSSIBILITIES
Provision of Car Parking - near public transit	oil prices and pollution	oil, rising prices, congestion
Provision of Car Parking - personal vehicles	oil prices and pollution	oil, rising prices, congestion
Cyclist Facilities	oil prices and pollution	oil, rising prices, congestion
Commuting Mass Transport	oil prices and pollution	oil, rising prices, congestion
Local Connectivity	oil prices and pollution	oil, rising prices, congestion

CREDIT: WATER	CURRENT REALITY	FUTURE POSSIBILITIES
Occupant Amenity Water	water shortages	increasing shortages
Water Meters	water shortages	increasing shortages
Landscape Irrigation	water shortages	increasing shortages

Heat Rejection Water	water shortages, power	increasing shortages
Fire System Water Consumption	protection	increased chance of fire from higher densities

CREDIT: MATERIALS	CURRENT REALITY	FUTURE POSSIBILITIES
Recycling Waste Storage	convenience (of not having to recycle)	recycling pick-up and drop-off bsn.
Building Reuse	convenience (of not having to recycle)	increasing regs and prices as matls and landfills reach limits
Reused Materials	convenience (of not having to recycle)	increasing regs and prices as matls and landfills reach limits
Shell and Core and Integrated Fit-out	meet basic tenant needs	tenants demand more but costs rise
Concrete	available but uncompetitive and dirty	increasingly expensive as construction increases; dirty
Steel	imported, not recycled	increasingly expensive as construction increases; more reused.
PVC Minimization	heavily used	unknown future
Sustainable Timber	no consideration to source	increasingly unavail as regulations increase
Design for Disassembly (eg disassembleable roofs)	not much available today	increasingly needed and available
Dematerialization	little used today	will be increasingly important
Local Sourcing	mostly rely on imports today	imports increasingly expensive, unavailable

CREDIT: SUSTAINABLE SITE DEVELOPMENT	CURRENT REALITY	FUTURE POSSIBILITIES
Conditional Requirements	little consideration today	increasing regulations
Topsoil	little consideration today	increasing regulations
Reuse of Land	little consideration today	increasing regulations
Reclaimed Contaminated Land	little consideration today	increasing regulations
Change of Ecological Value	little consideration today	increasing regulations

CREDIT: EMISSIONS	CURRENT REALITY	FUTURE POSSIBILITIES
Refrigerants/Gaseous Ozone Depleting Potential	existing regs not enforced	increasing enforcement
Refrigerants/Gaseous Global Warming Potential	existing regs not enforced	increasing enforcement
Refrigerant Leaks	existing regs not enforced	increasing enforcement
Insulant Ozone Depleting Potential	existing regs not enforced	increasing enforcement
Watercourse Pollution	existing regs not enforced	increasing enforcement
Discharge of Sewer	existing regs not enforced	increasing enforcement
Light Pollution	comfort	increasing concern
Legionella	subsistence, protection	increasing concern
Boiler and Generator Emissions	no regs today	regs likely

Appendix VI: The Matrix - Product Concepts

CREDIT: MANAGEMENT	CURRENT REALITY	FUTURE POSSIBILITIES
Green Star Accredited Professional	difficult to get certified	need for more certifiers in Ghana
Commissioning Clause	difficult to get commissioning	need for more commissioning
Building Tuning	difficult to get bldg tuning	need for more bldg tuning
Independent Commissioning Agent	difficult to get commissioning	need for more commissioning agents
Building Users Guide	difficult to educate tenants	need a Bldg Users Guide
Environmental Management	EPA regs are meaningless if not enforced	more enforcement
Waste Management	no strategy to manage waste	waste mgt strategy and enforcement
Air Tightness Testing	no process to measure air tightness	process to measure air tightness

CREDIT: INDOOR AIR QUALITY	CURRENT REALITY	FUTURE POSSIBILITIES
Ventilation Rates	no incentives to provide access to outside air	need regs or incentives to provide access
Air Change Effectiveness	no incentives to provide air exchange equip	need regs or incentives to provide equip
Carbon Dioxide Monitoring & Control	no incentives to monitor & control CO2	need incentives and awareness of issue
Daylight	no penalty for not complying with regs	need to impose a penalty
Daylight Glare Control	no incentives to provide glare control	decrease cost or increase consumer demand
High Frequency Ballasts	too expensive	decrease cost or increase consumer demand
Electric Light Levels	existing regs are vague, insufficient	decrease cost or increase consumer demand
External Views	views are provided when possible	light-directing prod (eg electrofluidic solar cells)
Thermal Comfort	no incentives to model thermal comfort	decrease cost or increase consumer demand
Individual Comfort Control	no incentives to model individual comfort	decrease cost or increase consumer demand
Hazardous Materials	insufficient and vague regs	decrease cost or increase consumer demand
Internal Noise Level	vague and unenforced bldg code	tighten language; increase enforcement

Volatile Organic Compounds (VOCs)	insufficient regs; products unavailable	local production of low-VOC paints
Formaldehyde Minimization	insufficient knowledge about dangers of form.	increase awareness level (workshops)

CREDIT: ENERGY	CURRENT REALITY	FUTURE POSSIBILITIES
Conditioning Requirement	insufficient regs., beyond ind control lack of alternative products on the market	energy efficiency, monitoring equipment onsight alt en (solar, wind, geo-thermal), petition gov for alt sources of energy (long term)
Greenhouse Gas Emissions	lack of knowledge about dangers of CO2	increase awareness (workshops)
Sub-Metering	exist in some but not all bldgs	provide incentives to increase usage
Lighting Power Densities	current level is slightly greater than credit allows	provide incentives to increase usage
Lighting Zoning	current practices do not provide light zoning	provide incentives to increase usage
Peak Energy Demand Reduction	complicated issue - more info needed	more info needed to understand opportunities

CREDIT: TRANSPORT	CURRENT REALITY	FUTURE POSSIBILITIES
Provision of Car Parking - near public transit	current regs are vague	mapping system to show best locations
Provision of Car Parking - personal vehicles	current regs are vague	provide more incentives
Cyclist Facilities	controversial; requires public debate	bicycle racks, repair facilities onsight
Commuting Mass Transport	beyond immediate scope of con-ind.	mapping showing tro tro routes
Local Connectivity	current regs are vague	increase awareness as to benefits of connectivity

CREDIT: WATER	CURRENT REALITY	FUTURE POSSIBILITIES
Occupant Amenity Water	insufficient and vague regs;	install water-efficient equipment
Water Meters	exist in some but not all bldgs	install water-efficient equipment
Landscape Irrigation	lack of regs; no incentives to install	install water-efficient equipment
Heat Rejection Water	expensive, rare	decrease costs of cooling towers
Fire System Water Consumption	rare; unknown level of regs	increase enforcement; raise safety awareness

CREDIT: MATERIALS	CURRENT REALITY	FUTURE POSSIBILITIES
Recycling Waste Storage	rare in practice; insufficient regs and awareness	increase awareness of need and benefits of recycling
Building Reuse	rare in practice; insufficient regs and awareness	increase awareness of need and benefits of bldg reuse
Reused Materials	rare in practice; insufficient regs and awareness	increase awareness of need and benefits of reused matl
Shell and Core and Integrated Fit-out	tenants demand specific amenities	increase awareness of need and benefits of minimizing retrofits
Concrete	concrete monopoly; no consideration to envir	patronize mom and pop competitors; encourage sustainable concrete
Steel	mostly imported; high transport emissions & cost	patronize local manufacturers; encourage sustainable steel
PVC Minimization	controversial issue; needs more research	conduct more research on PVC; continue to investigate alternatives
Sustainable Timber	lack of awareness of forest and timber issues	use sustainable timber only; substitute with non-timber
Design for Disassembly (eg disassembleable roofs)	in infancy; rare in practice	use disassembleable components
Dematerialization	rare in practice	dematerialize whenever possible
Local Sourcing	rare in practice	buy local whenever possible; petition gov to increase incentives to buy local and to start local co.

CREDIT: SUSTAINABLE SITE DEVELOPMENT	CURRENT REALITY	FUTURE POSSIBILITIES
Conditional Requirements	low priority - rare	increase mapping of avail land; publish land zoning maps online
Topsoil	low priority - rare	increase awareness of need; increase and enforce regs
Reuse of Land	low priority - rare	increase awareness of need; increase and enforce regs
Reclaimed Contaminated Land	low priority - rare	increase awareness of need; increase and enforce regs
Change of Ecological Value	insufficient regs and info; low priority	increase awareness of need; increase and enforce regs

CREDIT: EMISSIONS	CURRENT REALITY	FUTURE POSSIBILITIES
Refrigerants/Gaseous Ozone Depleting Potential	insufficient regs; low priority	increase awareness of need; increase and enforce regs
Refrigerants/Gaseous Global Warming Potential	insufficient regs; GW low priority	increase awareness of need; increase and enforce regs
Refrigerant Leaks	insufficient regs	increase awareness of need; increase and enforce regs
Insulant Ozone Depleting Potential	insufficent regs; ozone low priority	increase awareness of need; increase and enforce regs
Watercourse Pollution	low priority	increase awareness of need; increase and enforce regs
Discharge of Sewer	low priority	increase awareness of need; increase and enforce regs
Light Pollution	low priority	increase awareness of need; increase and enforce regs
Legionella	low priority	increase awareness of need; increase and enforce regs
Boiler and Generator Emissions	insufficient regs but are working on it	increase awareness of need; increase and enforce regs

Appendix VII: The Matrix - Extended Enterprise

CREDIT: MANAGEMENT	CURRENT REALITY	FUTURE POSSIBILITIES
Green Star Accredited Professional	lack of qualified candidates	institute training program to become Accredited Professional in Ghana
Commissioning Clause	lack of qualified candidates	institute training program to become a Commissioning Consultant in Ghana
Building Tuning	lack of qualified candidates	institute Building Tuning training
Independent Commissioning Agent	lack of qualified candidates	institute training program to become a Commissioning Consultant in Ghana
Building Users Guide	bldg owner resistance - cost, time, knowledge	collaborate with bldg industry to write a Bldg Users Guide
Environmental Management	lack of resources to enforce - staff, money, expertise	institute Environmental Management Training Program
Waste Management	lack of resources to enforce - staff, money, expertise	institute waste management awareness
Air Tightness Testing	low priority for contractors, expense, knowledge	institute air tightness awareness and training programs

CREDIT: INDOOR AIR QUALITY	CURRENT REALITY	FUTURE POSSIBILITIES
Ventilation Rates	low priority for contractors, expense, knowledge	work with the industry to amend the bldg code
Air Change Effectiveness	low priority for contractors, expense, knowledge	work with the industry to amend the bldg code
Carbon Dioxide Monitoring & Control	low priority for contractors, expense, knowledge	institute awareness and training programs
Daylight	low priority for contractors, expense, knowledge	work with the industry to amend the bldg code
Daylight Glare Control	low priority for contractors, expense, knowledge	work with the industry to amend the bldg code
High Frequency Ballasts	low priority for contractors, expense, knowledge	work with the industry to amend the bldg code
Electric Light Levels	low priority for contractors, expense, knowledge	work with the industry to amend the bldg code
External Views	low priority for contractors, expense, knowledge	work with the industry to amend the bldg code
Thermal Comfort	low priority for contractors, expense, knowledge	work with the industry to amend the bldg code
Individual Comfort Control	low priority for contractors, expense, knowledge	work with the industry to amend the bldg code
Hazardous Materials	low priority for contractors, expense, knowledge	Institute awareness and training

Internal Noise Level	low priority for contractors, expense, knowledge	work with the industry to amend building code
Volatile Organic Compounds (VOCs)	paint industry opposes change; few alternative products available	institute awareness and training programs
Formaldehyde Minimization	time commitment of contractors to learn about the issue	institute awareness and training programs

CREDIT: ENERGY	CURRENT REALITY	FUTURE POSSIBILITIES
Conditioning Requirement	industry opposes change - expensive, don't see the benefits	training and awareness programs + bldg code amendments
Greenhouse Gas Emissions	low priority for industry - lack of interest, time commitment	institute awareness and training programs
Sub-Metering	industry opposes change - expensive, oppose regs	work with the industry to amend the bldg code
Lighting Power Densities	industry opposes change - expensive, oppose regs	work with the industry to amend the bldg code
Lighting Zoning	industry opposes change - expensive, oppose regs	work with the industry to amend the bldg code
Peak Energy Demand Reduction	industry opposes change - expensive, oppose regs; industry will ignore or move away if too difficult to achieve	training and awareness programs + bldg code amendments

CREDIT: TRANSPORT	CURRENT REALITY	FUTURE POSSIBILITIES
Provision of Car Parking - near public transit	industry will ignore or move away if too difficult to achieve	training and awareness programs + bldg code amendments
Provision of Car Parking - personal vehicles	low priority for industry; lack of interest unless required	work with the city council to encourage bike use and bike lanes
Cyclist Facilities	controversial political issue - drivers vs. bikes	work with the city council to encourage bike use and bike lanes
Commuting Mass Transport	industry attempts to locate near mass transport, but not always possible	institute awareness and training programs
Local Connectivity	industry attempts to locate near mass transport, but not always possible	institute awareness and training programs

CREDIT: WATER	CURRENT REALITY	FUTURE POSSIBILITIES
Occupant Amenity Water	industry opposes changes unless tenants demand the product	institute awareness and training programs

Water Meters	industry opposes changes unless tenants demand the product	training and awareness programs + bldg code amendments
Landscape Irrigation	industry opposes changes unless tenants demand the product	training and awareness programs + bldg code amendments
Heat Rejection Water	industry opposes changes unless tenants demand the product	training and awareness programs + bldg code amendments
Fire System Water Consumption	industry opposes changes; expensive, oppose regs.	training and awareness programs + bldg code amendments

CREDIT: MATERIALS	CURRENT REALITY	FUTURE POSSIBILITIES
Recycling Waste Storage	low priority for contractors, expense, knowledge	training and awareness programs
Building Reuse	low priority for contractors, expense, knowledge	training and awareness programs
Reused Materials	low priority for contractors, expense, knowledge	training and awareness programs
Shell and Core and Integrated Fit-out	low priority for contractors, expense, knowledge	training and awareness programs
Concrete	strong concrete monopoly; significant barriers to entry	marketing program to 'buy local', local trade fair
Steel	significant barriers to entry	marketing program to 'buy local', local trade fair
PVC Minimization	industry opposes - do not see the advantage; few alternatives to PVC	continued research into the PVC product
Sustainable Timber	industry opposes - do not see the advantage; few alternatives to timber	training and awareness programs
Design for Disassembly (eg disassembleable roofs)	few contractors available	training and awareness programs
Dematerialization	industry opposes - do not see the advantages	training and awareness programs
Local Sourcing	very difficult - few sources available	marketing program to 'buy local', local trade fair

CREDIT: SUSTAINABLE SITE DEVELOPMENT	CURRENT REALITY	FUTURE POSSIBILITIES
Conditional Requirements	low priority for contractors, expense, knowledge	training and awareness programs + bldg code amendment
Topsoil	low priority for contractors, expense, knowledge	training and awareness programs + bldg code amendment
Reuse of Land	low priority for contractors, expense, knowledge	training and awareness programs + bldg code amendment

Reclaimed Contaminated Land	low priority for contractors, expense, knowledge	training and awareness programs + bldg code amendment
Change of Ecological Value	low priority for contractors, expense, knowledge	training and awareness programs + bldg code amendment

CREDIT: EMISSIONS	CURRENT REALITY	FUTURE POSSIBILITIES
Refrigerants/Gaseous Ozone Depleting Potential	industry opposes regs - do not see the advantages	training and awareness programs + bldg code amendment
Refrigerants/Gaseous Global Warming Potential	industry opposes regs - do not see the advantages	training and awareness programs + bldg code amendment
Refrigerant Leaks	industry opposes regs - do not see the advantages	training and awareness programs + bldg code amendment
Insulant Ozone Depleting Potential	industry opposes regs - do not see the advantages	training and awareness programs + bldg code amendment
Watercourse Pollution	industry opposes regs - do not see the advantages	training and awareness programs + bldg code amendment
Discharge of Sewer	industry opposes regs - do not see the advantages	training and awareness programs + bldg code amendment
Light Pollution	low priority for industry	training and awareness programs + bldg code amendment
Legionella	low priority for industry	training and awareness programs + bldg code amendment
Boiler and Generator Emissions	industry opposes regs - do not see the advantages	training and awareness programs + bldg code amendment

Appendix VIII: The Matrix – Advocates for Change and Points of Influence

CREDIT: MANAGEMENT	ADVOCATE FOR CHANGE	POINTS OF INFLUENCE
Green Star Accredited Professional	construction industry	Ghana Green Building Council
Commissioning Clause	construction industry	Ghana Green Building Council
Building Tuning	construction industry, Ghana Green Building Council	GREDA
Independent Commissioning Agent	construction industry	Ghana Green Building Council
Building Users Guide	construction industry	architects, construction industry
Environmental Management	Ghana Green Building Council	EPA
Waste Management	Ghana Green Building Council	Public Works Dept.
Air Tightness Testing	Ghana Green Building Council	GREDA

CREDIT: INDOOR AIR QUALITY	ADVOCATE FOR CHANGE	POINTS OF INFLUENCE
Ventilation Rates	Ghana Green Building Council	Bldg Code Standards Commission, EPA
Air Change Effectiveness	Ghana Green Building Council	Bldg Code Standards Commission, EPA
Carbon Dioxide Monitoring & Control	Ghana Green Building Council	GREDA, GhGBC, EPA, Bldg Code Standards Comm.
Daylight	Ghana Green Building Council	Bldg Code Standards Comm, EPA
Daylight Glare Control	Ghana Green Building Council	Bldg Code Standards Commission
High Frequency Ballasts	Ghana Green Building Council	Bldg Code Standards Commission
Electric Light Levels	Ghana Green Building Council	Bldg Code Standards Comm, GREDA
External Views	Ghana Green Building Council	Bldg Code Standards Comm, GREDA
Thermal Comfort	Ghana Green Building Council	Bldg Code Standards Comm, GREDA
Individual Comfort Control	Ghana Green Building Council	Bldg Code Standards Comm, GREDA
Hazardous Materials	Ghana Green Building Council	Bldg Code Standards Comm, EPA
Internal Noise Level	Ghana Green Building Council	Bldg Code Stds Comm,
Volatile Organic Compounds (VOCs)	Ghana Green Building Council	Bldg Code Stds Comm, EPA
Formaldehyde Minimization	Ghana Green Building Council	Bldg Code Stds Comm, EPA
Mold Prevention	Ghana Green Building Council	Bldg Code Stds Comm, EPA

Tenant Exhaust Riser	Ghana Green Building Council	Bldg Code Stds Comm, GREDA
Environmental Tobacco Smoke Avoidance	Ghana Green Building Council; anti-smoking advocates	NGOs (eg, Dangers of Smoking Awareness Campaigns)

CREDIT: ENERGY	ADVOCATE FOR CHANGE	POINTS OF INFLUENCE
Conditional Requirements	Ghana Green Building Council; alternative energy advocates	Energy Commission, Bldg Code, GhGBC, GREDA
Greenhouse Gas Emissions	Ghana Green Building Council; alternative energy advocates	Energy Commission, Bldg Code, GhGBC, GREDA
Sub-Metering	Ghana Green Building Council; alternative energy advocates	Bldg Code Stds Comm.
Lighting Power Densities	Ghana Green Building Council; alternative energy advocates	Bldg Code Stds Comm.
Lighting Zoning	Ghana Green Building Council; alternative energy advocates	Bldg Code Stds Comm.
Peak Energy Demand Reduction	Ghana Green Building Council; alternative energy advocates	Energy Commission; local utility company

CREDIT: TRANSPORT	ADVOCATE FOR CHANGE	POINTS OF INFLUENCE
Provision of Car Parking - near public transit	public transport advocates	public works; Min of Transportation; NGOs
Provision of Car Parking - personal vehicles	public transport advocates	City Council
Cyclist Facilities	bicycle coalition and advocates	City Council
Commuting Mass Transport	public transport advocates	Zoning Dept; Ministry of Transportation; NGOs
Local Connectivity	public transport advocates	Zoning Dept; Ministry of Transportation; NGOs

CREDIT: WATER	ADVOCATE FOR CHANGE	POINTS OF INFLUENCE
Occupant Amenity Water	Ghana Green Building Council; water conservation advocates	education - GhGBC, GREDA, local utility, NGOs
Water Meters	Ghana Green Building Council; water conservation advocates	local utility dept., Bldg Code Stds Comm
Landscape Irrigation	Ghana Green Building Council; water conservation advocates	local utility dept., Bldg Code Stds Comm
Heat Rejection Water	Ghana Green Building Council	Bldg Code Stds Comm
Fire System Water Consumption	Ghana Green Building Council	Bldg Code Stds Comm

CREDIT: MATERIALS	ADVOCATE FOR CHANGE	POINTS OF INFLUENCE

Recycling Waste Storage	Ghana Green Building Council; recycling advocates	recycling companies, local sanitation co, public works
Building Reuse	Ghana Green Building Council; recycling advocates	GhGBC, GREDA, local sanitation co, public works
Reused Materials	Ghana Green Building Council; recycling advocates	GhGBC, GREDA, local sanitation co, public works
Shell and Core and Integrated Fit-out	Ghana Green Building Council; recycling advocates	GhGBC, GREDA, local sanitation co, public works
Concrete	mom & pop concrete mfg co who want to break into the mkt	Congress (building subsidies)
Steel	mom & pop concrete mfg co who want to break into the mkt	Congress (building subsidies)
PVC Minimization	Ghana Green Building Council; universities	GhGBC, GREDA, NGOs, universities
Sustainable Timber	Ghana Green Building Council; universities	GhGBC, GREDA, NGOs, universities
Design for Disassembly (eg disassembleable roofs)	disassembling companies who want to break into the mkt	GhGBC, GREDA, NGOs, universities
Dematerialization	Ghana Green Building Council; recycling advocates	GhGBC, GREDA
Local Sourcing	Ghana Green Building Council; Buy Local campaigns	GhGBC, GREDA

CREDIT: SUSTAINABLE SITE DEVELOPMENT	ADVOCATE FOR CHANGE	POINTS OF INFLUENCE
Conditional Requirements	Ghana Green Building Council	Zoning Dept, EPA
Topsoil	Ghana Green Building Council	Zoning Dept, EPA
Reuse of Land	Ghana Green Building Council	Zoning Dept, EPA
Reclaimed Contaminated Land	Ghana Green Building Council	Zoning Dept, EPA
Change of Ecological Value	Ghana Green Building Council	Zoning

CREDIT: EMISSIONS	ADVOCATE FOR CHANGE	POINTS OF INFLUENCE
Refrigerants/Gaseous Ozone Depleting Potential	Ghana Green Building Council; clean air, water and soil advocates	EPA, bldg stds comm
Refrigerants/Gaseous Global Warming Potential	Ghana Green Building Council; clean air, water and soil advocates	EPA, bldg stds comm
Refrigerant Leaks	Ghana Green Building Council; clean air, water and soil advocates	EPA, bldg stds comm
Insulant Ozone Depleting Potential	Ghana Green Building Council; clean air, water and soil advocates	EPA, bldg stds comm

Watercourse Pollution	Ghana Green Building Council; clean air, water and soil advocates	EPA, public works; GhGBC, GREDA
Discharge of Sewer	Ghana Green Building Council; clean air, water and soil advocates	EPA, public works; GhGBC, GREDA
Light Pollution	Ghana Green Building Council	bldg stds comm
Legionella	public health advocates	bldg stds comm
Boiler and Generator Emissions	Ghana Green Building Council	bldg stds comm; Attorney General (reviewing proposed regs)

Appendix IX: Exploratory Interview Information

Name	Expertise	Date	Length of Interview
Sammy Amegayibor	Executive Director of GREDA	2/24/14	20 minutes
Foster Osae-Akonnor	Executive Director of GHGBC	2/23/14	1 hour 22 minutes
Susan Djokoto	Professor at the Kumasi Polytechnic, Ghana	2/26/14	32 minutes

Appendix X: Exploratory Interview and FSSD Analysis and Gaps

	Ghanaian Construction Industry, Current Reality	**FSSD**	**Gaps**
System Level	No green building developers	Awareness of social and environmental systems	Less emphasis on society and biosphere during development
Success Level	Earning a profit from a completed project	Sustainability Principles	No uniform definition of success Lack of a shared vision among stakeholders towards sustainability
Strategic Level	Forecasting	Backcasting from the SPs	Unclear guidelines obscured by financial challenges
Action Level	Building actions are taken by Town Planning Authorities Poor co-ordination of information among government institutes	Actions should violate the sustainability principles	Less interaction of multi-stakeholder for sustainable development
Tool Level	Ghana Green Star RateTool	Template for Sustainable Product Development	Various tools exists but may not result in strategic sustainable development

Appendix XI: Interview Questions

	Interview Questions for Stakeholder
1	How would you describe the construction industry as it stands today?
2	What role do you think construction plays in Ghana's (sustainable) development?
3	How does politics affect the buildings construction in Ghana?
4	What aspects of Ghana's rapid growth concern you the most?
5	What impact will it have on your business?
6	How can the economy of Ghana drive development in the buildings construction?
7	How much of the economy does the construction industry make up?
8	What kind of data would you need to convince you that there is economic benefit to sustainability?
9	To your understanding, how does the buildings construction affect the environment?
10	Are there any policies in place that you know of pertaining to green building or consideration for the built environment? What are your thoughts on these opportunities?
11	What policies would you like to see the government implement to help move towards sustainable development?
12	Do you think technological innovation have an influence on the buildings construction?
13	What are your biggest concerns for your business? Profit? Long-term survival?
14	What are the biggest challenges facing the industry today?
15	Do you think these challenges will be overcome? (How so?)
16	Are there opportunities for industry professionals to gather and discuss the development of the industry?
17	What types of collaborations exist between the industry's stakeholders?
18	What are the main roles in the industry?
19	Who within the industry do you work with the most?
20	What aspirations do you have for the industry?

Appendix XII: Interviewees' Demographic Information

	Interviewee	Position	Date of Interview	Length of Interview
1	Yaw Amoako Amoako	Architect and Local Contractor	3/31/14	69min.
2	Louis Satchmo Atongo	Managing Director , Architectural and Engineering Services Limited	3/31/14	23min.
3	Samuel B. Adjiri	Ag. Finance Officer, GREDA	4/1/14	55min.
4	Bashir Ahmed	Individual and Property Owner	4/4/14	120min.
5	Albert Ameyedor	Resident, Medical Researcher	4/5/14	30min.
6	Gideon Commey	Campaign Strategist, Ghana Youth Environmental Movement	4/1/14	75min.
7	Abdulai Bukari Braimah	Executive Director, Rural-Urban Women and Children	4/1/14	75min.
8	Dan Benefor	Climate Change Division Environmental Protection Agency, Ghana	4/3/14	40min.
11	Sammy Amegayibor	Executive Director of GREDA	4/1/14	55min.
12	Foster Osae-Akonnor	Executive Director of GHGBC	4/3/14	79min.

Appendix XIII: Construction Industry Stakeholders

Architects and Designers
Associations
Ghana Real Estate Development Association (GREDA)
Ghana Green Building Council (GHGBC)
South Africa Green Building Council (GBCSA)
World Green Building Council (GBC-W)
Australia Green Building Council (GBC-A)

Businesses
Developers
Contractors: steel, concrete, glass, metal, wood, iron, roof, HVAC, landscaping
Sub-contractors
Sales agents
Lenders
Petroleum industry, mining industry, timber industry

Consultants
GBC accreditor consultant
Commissioning agents

Environment

Future Generations

General Public
Building owners (eg of high rise and commercial buildings and land)
Individual unit owners (purchasers, owner-occupants eg of townhouses, condos)
Tenants (rent, don't own)
Bicycle coalition
Special interest groups

Government and Quasi-Governmental Agencies
Global – eg U.N., World Bank, World Economic Forum
World Business Council for Sustainable Development
Continent (African Continent) agencies, Pan-African Union and Parliament
National (Ghana)
Agencies:
EPA
Ghana Natl Petroleum Corp – state-owned, regulates the petroleum industry.
Ghana Oil Co – state-owned, administers the petroleum in dregs.
Ministries:
Ministry of Energy
Ministry of Health
Ministry of Water Resources Works

Housing and Institutions of Higher Learning & Organizations
Commissions:
Ghana Energy Commission
Regional council (like our counties, states)
City:
City council
Public Works
Land use
Building Department
Permit Department

NGOs
Forests
Transportation (including bikes)
Water
Alternative energy and energy efficiency

Suppliers

Universities
Kumasi
Accra

Utilities
Gas and electric
Ghana Grid Company
Northern Electricity Distribution Company
Electricity Company of Ghana
Water
Sanitation
Waste mgt.
Recycling