Barriers to the adoption of green certification of buildings

A thematic analysis of verbatim comments from built environment professionals

Kofi Agyekum, Emmanuel Adinyira, Bernard Baiden and Godslove Ampratwum
Department of Construction Technology and Management, Kwame Nkrumah University of Science and Technology, Kumasi, Ghana, and
Daniel Duah
Department of Architecture, Kwame Nkrumah University of Science and Technology, Kumasi, Ghana

Received 31 January 2019
Revised 4 April 2019
Accepted 14 April 2019

Abstract

Purpose – This paper aims to identify the key barriers to the adoption of green certification of buildings in Ghana.

Design/methodology/approach – The study adopts face-to-face and telephonic interviews with ten built environment professionals, using a semi-structured interview guide. Qualitative responses to the interview were thematically analysed using NVivo 11 Pro analysis application software.

Findings – The findings suggest that "lack of information on existing green buildings", "lack of incentives", "conservative nature of Ghanaians", "lack of active government participation", "inadequate human resource", "lack of awareness of the benefits", "cost and financing" and "lack of legal backing" are the eight key barriers that hinder the adoption of green certification of buildings.

Research limitations/implications – The research is limited to built environment professionals registered with their appropriate professional bodies. The findings cannot be generalized and extended to other developing countries that do not share similar characteristics and context with Ghana.

Practical implications – Practically, this study highlights, for the benefit of the construction industry and the government, the critical barriers to the adoption of green certification of buildings in Ghana. Identification of these barriers provides a pathway for the provision of pragmatic solutions towards the adoption of green buildings in Ghana.

Originality/value – Findings of the research make significant contribution to the debate on the barriers to the adoption of green certification of buildings. Four out of the eight barriers (inadequate awareness of the benefits of green certification of buildings, inadequate human resource, conservative nature of Ghanaian and lack of information on existing green buildings) identified are unique in the context of other related studies and advanced knowledge on the subject matter.

Keywords Ghana, Green buildings, Built environment professionals, Green certification

Paper type Research paper

1. Introduction

The construction sector is the world's heaviest consumer of natural resources and accounts for 40 per cent of total global carbon dioxide (CO_2) emissions and 30 per cent of global raw-material consumption and solid-waste output. Therefore, this sector has a huge potential for CO_2 reduction (Department for Communities and Local Government: London, 2007). Additionally, buildings are responsible for consuming one-sixth of the world's freshwater, one-fourth of the world's wood harvesting and two-fifths of the world's matter and energy

Journal of Engineering, Design and Technology
Vol. 17 No. 5, 2019
pp. 1035-1055

1726-0531
DOI 10.1108/JEDT-01-2019-0028

(Alshuwaikhat and Abubakar, 2008). With the increase in environmental awareness and a focus on preserving the environment, governments and the public worldwide are responsible for controlling the consumption of natural resources and further identifying innovative and efficient alternatives that potentially lead to sustainable development (Mosly, 2015). CO_2 emissions and global warming are serious international issues (Park *et al.*, 2013), and there have been numerous international efforts to promote innovative approaches to control the CO_2 emissions from building construction and operation activities (Park *et al.*, 2013). With the increased record of destruction to the environment, there is now a worldwide call for the construction sector to go green. Green buildings are now becoming a major priority of construction industries worldwide. Also known as sustainable buildings, green building is the practice of creating structures and using processes that are environmentally responsible and resource-efficient throughout a building's life cycle (Wei *et al.*, 2015). Buildings designed and constructed this way are also known as green buildings because they strive for environmentally more sustainable buildings that can be energy-efficient and less-polluting and that can provide a healthier environment for their users (Hoffman and Rebecca, 2008; Richardson and Lynes, 2007). The construction of greener buildings has been identified to provide several advantages to customers. For instance, in Brazil, customers of green buildings report on the appreciation of the property, a 50 per cent reduction in water consumption, 30 per cent reduction in energy consumption and 80 per cent reduction in waste generation, besides an average appreciation of 15 per cent in their resale price (Green Building Council Brazil, 2012).

The increased advantages associated with green buildings has given rise to an upsurge in its adoption worldwide. The UK records over 115,000 certified green buildings with additional 700,000 registered for eventual certification (Ozolins, 2010). Canada records over 480 certified green buildings (Redl, 2013), and Australia records over 148 certified green buildings (Ozolins, 2010). However, in Africa, not much is known about the adoption and diffusion of the green building concept, though countries such as South Africa (which records a total of 36 green buildings) and Kenya are on the path of leading its adoption. In the quest to join the leaders in green certified buildings in the world and in Africa, Ghana is on the verge of embracing this new order. Though with little experience, when it comes to the green certification of buildings, Ghana first recorded the adoption of a certification system, called The Green Star South Africa-Ghana, in 2009. This green certification system was used to certify Ghana's first green building called One Airport Square located in Accra (Wiafe, 2017). Subsequently, the Green Star South Africa-Ghana was used to certify Stanbic heights (Wiafe, 2017) building in Accra. Following the gradual success, the LEED certification system was also adopted and used to certify the Ridge Hospital (Leber, 2017) and United Nations Building (Wiafe, 2017). Though the World Bank Building was not certified with LEED, green building approaches underpinned in LEED were used (www.co-arc.com/offices-for-the-world-bank-group-ghana). Currently, the Edge certification has been used to certify the Baby and Mother Unit at Komfo Anokye Teaching Hospital in Kumasi, Ghana (www.edgebuildings.com/projects/mbu/). With the successes obtained in the adoption and usage of these certification systems, it is evident that the path for the adoption of green building certification systems is clear. This notwithstanding, the number of green buildings in Ghana is still low as compared to other countries. Could this problem be a result of the lack of development of an appropriate certification system that better suits the environmental and other conditions of Ghana? Or could it be a result of the fact that some of the adopted systems such as the Green Star South Africa, which was used to certify the One Airport Square, suit the conditions of Ghana, but certain barriers hinder its adoption for certifying other emerging buildings? According to Berry *et al.* (2013), any change towards

sustainability practice faces several barriers. Such has been the fate of countries such as South Africa (Windapo, 2014), Hong Kong and Singapore (Chan *et al.*, 2009), Australia (Zou and Couani, 2012) and China (Liu *et al.*, 2012; Zhang *et al.*, 2011). In addition to the few studies conducted on barriers to the adoption of green buildings in developing countries, Chan *et al.* (2018) conducted an extensive investigation to determine the critical barriers to green building technologies adoption in Ghana and identified government-related issues, human-related issues, knowledge- and information-related issues, market-related issues and cost- and risk-related issues to be critical in the adoption of green building technologies. Their study performed a comprehensive literature review and identified 26 barriers from which a questionnaire was prepared and administered to 43 professionals with green building experience in Ghana. Again, in their study, Chan *et al.* (2018, p. 1069) indicated that "the identification of the 26 potential barriers focused mainly on factors that have received considerable attention in previous studies conducted in different countries and contexts", and backed this assertion with the argument of Rowlinson (1988) that it is more appropriate to use well-known factors for a research study, as that would allow respondents to answer easily. In spite of the well-justified assertion of Chan *et al.* (2018), this study postulates that allowing the professionals to choose the critical barriers within the 26 identified barriers restricted them, thereby making it difficult for them to provide their verbatim comments on other equally potential barriers. Therefore, there is the need for this potential gap to be filled, and this study is conducted to give built environment professionals the opportunity to provide their verbatim views on the potential barriers to the adoption of green certification of buildings in Ghana in spite of the numerous advantages reported in literature on this concept. It is important to note that while the authors do not seek to downplay the significant work produced by Chan *et al.* (2018) and other researchers, the findings from this study should complement existing research, which is heavily reliant on international perspectives with respect to barriers to adoption of green buildings. By so doing, the study can advance literature to include additional barriers to the already existing barriers to green buildings certifications, especially within the context of a developing country such as Ghana.

2. Literature review

2.1 Overview of green buildings

The term "Green" refers to environment-friendly practice from building design to the landscaping choices (Chandra, 2018). Many definitions of green buildings exist today. A green building can be defined as the practice of building structures and implementing procedures that are responsible towards the environment and resource-efficient throughout the life cycle of the building (EPA, 2016; Wei *et al.*, 2015). According to the World Commission on Environment and Development (WCED) – Our Common Future (1987), such buildings are structures which are designed to promote efficient use of resources and to reduce the adverse effects of buildings on the environment. Such buildings are called "green buildings" because they strive for environmentally more sustainable buildings which are energy-efficient and less-polluting and provide a healthier environment for their users (Richardson and Lynes, 2007; Hoffman and Rebecca, 2008). Clevenger (2008) stressed that green buildings save energy and water but also contribute to the occupant's health and comfort through measures taken in terms of temperature and humidity control, indoor air quality, natural lighting and waste management. In another context, McGraw-Hill (2013) defined green building as a construction project that is either certified under a recognized global green rating system or built to qualify for certification. Chandra (2018) expounded the definition of McGraw-Hill (2013) and indicated that the term "green building" applies not

only to products but also to construction strategies, building design and construction practice and promotes the economic health and well-being of end-users. Hence, the adoption of green building materials is an excellent approach to meeting this target. Selection of construction materials which create minimum environmental burden is useful in the sustainable development of a country. Saad (2016) defined green building as a building that is energy-efficient, resource-efficient and environmentally responsible. He defined green building as a building which is energy-efficient, resource-efficient and environmentally responsible (Saad, 2016). The usage of renewable energy technological innovations is pivotal for achieving green building objectives and accreditation (Shi *et al.*, 2013). This is because of the depletion of energy resources and its associated environmental issues. Construction and demolition waste control also plays a critical role in achieving green buildings (Kibert, 2008). One of the key elements of sustainable design is to reduce the consumption of resources and to improve the resource-usage efficiency (Webster and Dunn, 2011; Poon *et al.*, 2013). One of the common approaches is to reduce, recycle and reuse construction and demolition waste (Tingley and Davison, 2012). The adoption of green building materials is an excellent approach to green building. The selection of construction materials which create minimum environmental burden is useful in the sustainable development of a country (Singh, 2018). The benefits and advantages of green buildings are enormous, as they come in the form of lower development costs which lower operating costs, increase comforts, ensure healthier indoor environment quality, enhance durability and ensure lower maintenance costs (Singh, 2018).

2.2 Green building certification

Recently, green buildings are typically defined and categorized by green certification systems (Steinemann *et al.*, 2017). The drive for green buildings motivated the creation of several systems, and many countries worldwide now have their own certification systems. Key among these certification systems are: Building Research Establishment Environmental Assessment Methodology, BREEAM, developed in the UK in 1990 (BRE, Building Research Establishment Environmental Assessment Methodology BREEAM, 2016); Leadership in Energy and Environmental Design, LEED, developed in the USA in 1994 (US Green Building Council, 2016); DGNB, Deutsche Gesellschaft für Nachhaltiges Bauen. (2016); Comprehensive Assessment System for Built Environment Efficiency, CASBEE, Comprehensive Assessment System for Built Environment Efficiency, 2016); and Green Star System developed in Australia Green Building Information Gateway, GBCA. (2016).

According to Cidell (2009), literature suggests that developers and owners worldwide now have strong motivations to pursue green building certifications because of the economic, social and ecological benefits associated with it. Following this, Steinemann *et al.* (2017) indicated that over 145,000 green certification projects had been completed around the world in 2016 using some of the various certification systems. The World Green Building Trend Smart Market Report (2016) indicated that the percentage of firms worldwide with over 60 per cent of their projects certified as green was forecast to grow from 18 per cent in 2016 to 37 per cent in 2018. Following the continuous report of the advantages associated with green building certifications in literature, Steinemann *et al.* (2017, p. 351) report that "more than 31 green building certification systems and 55 schemes within those systems are used in over 30 countries around the world, with some of the systems (e.g. BREEAM and LEED) being used in multiple countries". In Africa, South Africa and Kenya have taken the lead in green building certifications. However, with the worldwide call for construction

industries to go green, it is hoped that many other African countries will better appreciate the benefits associated with going green.

2.3 Barriers to the green certification of buildings

The development of green buildings involves a combination of multiple economic sectors and the formation of an industrial chain from planning, architecture design, material manufacturing, construction to operation management and demolition (Deng *et al.*, 2018). Berry *et al.* (2013) indicated that to move to the green building paradigm, there is the need to significantly shift from the current practices in the construction industry. Berry *et al.* (2013) further iterated that such shifts may involve changes in policies, professional norms, national standards, technologies and consumption behaviours. Hence, there is a surety this shift will encounter hurdles that need to be crossed. Barriers to the adoption of green certification systems are vastly reported in literature (Deng *et al.*, 2018; Hu *et al.*, 2014; Windapo, 2014; Shapira *et al.*, 2014; Zou and Couani, 2012; Liu *et al.*, 2012). Such barriers must therefore be understood to promote the smooth shift to the adoption of green buildings (Chan *et al.*, 2009).

It is necessary to note that these barriers differ from one country to another as a result of culture, environmental, economic and political factors that can influence the quantity and severity of these barriers. Just like any new concept, the penetration and quick diffusion is quite challenging within any market. Hence, identifying green building barriers and setting strategies to overcome these barriers will enable stakeholders to gain confidence in their continuous implementation (Warren and Taylor, 2008). Although the adoption of green certification of buildings has been drummed into the ears of practitioners through research and other mediums, its adoption in Ghana is still plagued with barriers which need detailed investigation to uncover and address appropriately. As a guide, the sub-sections below discuss some of the barriers identified in literature. This discussion is necessary to provide an appropriate platform against which the barriers identified by the built environment professionals in Ghana could be discussed.

2.3.1 Lack of proper regulatory processes and codes. Roles played by the government are highly significant when it comes to green building promotion (Mosly, 2015). The role of government can be in the form of regulations, as stated by Powmya and Abidin (2014) that the government is key in the enforcement and revision of existing legislation and policies. Governments or public authorities have adopted several regulations and policies aimed at incentivizing or mandating green building practices (DuBose *et al.*, 2007). These regulatory and legislative requirements put pressure on all major construction stakeholders to either adopt it or face its consequences. Regulatory and legislative requirements are effective and influential in both leading change and raising awareness (Amjad *et al.*, 2012). The government can set several regulations that support green certification of buildings, which obliges the public to adopt it (Amjad *et al.*, 2012).

2.3.2 Lack of database on using green building assessment system. Inadequate data on the use of green building valuation system is a barrier (Shi, 2009). When there is no easily accessible record for green materials and its product, which is very much needed for assessment, it drives people away from adopting after they have become aware of its benefits (Shi, 2009). According to Chang *et al.* (2015), lack of database and knowledge of green building certification systems are key obstacles to the adoption of the certification system. The green specification (catalogue on green products and associated technical standards) enhances the mindfulness of project members to easily obtain the needed information for green buildings (Zuo and Zhao, 2014). This is surely a new and upcoming

field, and new products such as EcoSpecifier are giving help on environmental impact of generally obtainable building products (Wilson and Tagaza, 2006).

2.3.3 Lack of training and education. The development of green building certification hinges on the availability of skilled and trained people to fill the emerging green jobs (Hammer *et al.*, 2012). Opoku and Ahmed (2015) found that there was a shortage of skilled employees with expertise in green building. For a tremendous increase in green building certifications, the professionals in the industry must be endowed with green construction skills. However, this requirement has not yet been obtained. Notwithstanding, a handful of architects and engineers are skilled with project design and construction, but not much can be said of them when it comes to green building assessment practice (Shi, 2009). There is a direct relationship between performance and experience of project members (Young and Samson, 2008). Experience and skills are imperative for increasing environmental experience and performance (Li *et al.*, 2014). Comparing green buildings to conventional buildings is imperative because green buildings make use of biodegradable materials, cutting-edge simulation and analysis and indoor environmental quality measures (Li *et al.*, 2014). Therefore, there is a need to educate and train people to acquire the required expertise in their respective fields. According to Marsh (2009), inadequate experience of consultants and contractors, when it comes to green building works, results in unsurmountable delays in projects. Often, the knowledge on green building methods and construction are complicated and require training (Zhang *et al.*, 2011). Tagaza and Wilson (2004) iterated that the problems encountered during green building design and construction are because of lack of knowledge (Hwang and Tan, 2012). In the view of Durmus-Pedini and Ashuri (2010), contractors might also lack the skill to adopt green-oriented technology. This, according to Tagaza and Wilson (2004), may be a result of the fact that green technologies are mostly quite difficult and vary from traditional technologies. The need for training professionals in the green certification system should therefore not be underestimated.

2.3.4 Lack of interest from developers. According to Shi (2009), without ultimate rewards, developers are not concerned about adopting green building tools to check and improve their project performances. In spite of the increased advantages associated with the adoption of green certification systems, the systems has not been fully embraced by developers. These developers are mostly concerned with making profits; hence, moving entirely to green certification of buildings, which mostly requires new service providers, material sellers and the adoption of an integrated design process, is seen as an extra cost.

2.3.5 First-cost barrier. First-cost barrier is a significant disincentive to the adoption of sustainable principles in buildings. However, a lot of people make the mistake of doing basic calculations which mostly lead to high prices for green buildings, and this makes them choose conventional buildings (Mosly, 2015). Zhou and Lowe (2003) posit that developers and investors have fallacy misconception that capital costs could rise if they veer into green construction, and they lack the understanding of green methods in construction. The ingress of innovative technologies from other countries also influences costs of adoption (Iwaro and Mwasha, 2010). There are inadequate support systems to offer distinct funds to assist technologies for building development (Zhang and Wang, 2013). The most frequently seen barriers are the dread of higher cost of investment of green buildings in relation to conventional buildings and the risks of unexpected costs (Hakkinen and Belloni, 2011).

2.3.6 Risks and uncertainties associated with green building certifications. Though investments and interests in green buildings are on the rise, there exist a few risks and uncertainties associated with its adoption. The fear for green building adoption compared to traditional buildings and the risks of unforeseen costs are the most commonly addressed barriers for green buildings (Hydes and Creech, 2000; Larsson and Clark, 2000). According

to a report by Marsh (2009), the building performance risk is rated to be one of the highest in the growth of implementation of green buildings. Durmus-Pedini and Ashuri (2010) indicated that building performance assessment has a significant influence on the decision-making process in the implementation of green buildings. For instance, Turner and Frankel (2008) reported some LEED buildings to be of high energy usage; however, the cause was later attributed to inefficient energy building performance owing to the actions of the occupants and the facility managers in the building, together with the malfunction of technologies and systems in the building.

2.3.7 Procurement and tendering processes. Green design depends critically on the type of contract selected for the project (Tagaza and Wilson, 2004). When the contract used for green projects does not include the specifications of a complete implementation of green designs, difficulties are likely to be encountered (Hwang and Tan, 2012). One of the most important obstacles to a successful green building is the difficulty in describing its requirements (Hakkinen and Belloni, 2011). Adetunji *et al.* (2008) postulated that focus on the price of procurement practices and low-risk culture are the main barriers for sustainable supply chain (Hakkinen and Belloni, 2011). This is because as procurement practices focus on price, the sustainability issues are not dealt with as contractual deliverables but rather as issues of faith. Ang *et al.* (2005) asserts that because procurement processes are fundamental to improving building performance and ensuring more sustainable buildings, there is a need to change to a procurement system that draws upon the knowledge of requirements at all stages of the project.

2.3.8 Project-delivery mechanisms. Models of cooperation and networking, models of communication, roles of different actors, decision-making and management processes and the scheduling of tasks are process-related possible barriers for green buildings (Hakkinen and Belloni, 2011). The right timing and the presence of all needed actors in specific phases of sustainable building projects are addressed as key issues for the success of the projects. The roles of construction organizations are essential in providing estimating services. Accurate estimation of costs in the early stages of green building projects supports projects to select high performance and green building features based on the owner's budget (Hakkinen and Belloni, 2011). This means that the accurate estimation of costs in the early phases of green building projects is crucial. Wilson and Tagaza (2006), affirm that the type of contract selected for the delivery of the project will have a significant impact on the success of developing and implanting a green design. According to Wilson and Tagaza (2006), a traditional construction tender based on detailed design documentation or "novation" contract or an "alliance" contract can be successfully used for the delivery of green commercial buildings. However, "design and build" contract or "public–private partnership" cannot successfully deliver green commercial buildings because of the design being locked in at an early stage before being fully developed and integrated. Buys and Hurbissoon (2011) posits that contractors play a role in "green building" by recycling and reusing construction debris, limiting the use of hazardous materials, protecting vegetation and using more efficient production systems. Integrated procurement systems (e.g. design and build, turnkey and engineer, procure and construct [EPC]) would however permit contractors to participate more actively in green building design.

2.3.9 Integrated design teams. Successful green building projects require a considerable amount of investment in an integrated design team at the early stage, with the following represented in the team: project owner, project manager, building contractor, architect, services engineer, structural engineer, environmental engineer, civil engineer, cost planner, building surveyor and acoustic expert (Wilson and Tagaza, 2006). Traditionally, conceptual designs are conceived by architects and developers and then

passed on to the structural and services engineers and builders for design and construction. According to Elforgani and Rahmat (2010), architectural, mechanical and electrical designs are the most influential in the green building design process because these systems affect the building envelope, choices of materials and energy efficiency. Green buildings involve building orientation, energy consumption, ventilation and lighting considerations that drive the design and the relevance of expertise of the services engineer at the conceptual stage (Buys and Hurbissoon, 2011). This is in contrast with traditional buildings where the services engineer is only given the final design and asked to provide the lighting, heating and cooling systems to the sealed building (Buys and Hurbissoon, 2011). The disadvantage is that the integrated design process takes longer, but it is necessary to understand that the anticipated life-cycle savings can only be realized if the green building features and practices are fully integrated at the conceptual stage so that they function as one holistic system rather than stand-alone independent systems. Sodagar and Fieldson (2008) further iterated that to design a green building, the design team needs to have access to the best available information on products and tools. Green building requires the overall management of building performance and life-cycle impacts, along with effective communication and cooperation (Hakkinen and Belloni, 2011). Horman *et al.* (2006) addressed the importance of cooperation in green building projects and suggested the use of design-build-operate-maintain (a delivery method that integrates the designers, contractors and operation and the maintenance). Deane (2008) stated that the preferred design model for delivering a green building is an integrated design process, which includes all involved parties (the owner, the developer, the designers, the builder, the tenant and the facility operator) from the beginning. Green building projects require careful material and system selection early in the project-delivery process. Rohracher (2001) points out that green buildings cannot be properly constructed without a much closer interaction of suppliers, professionals and users.

2.3.10 Lack of support from manufacturers and suppliers. Using environmentally preferable building products and materials enables commercial and residential developers and builders to reduce the use of energy resources required to produce building products and materials and save energy-resources consumption during construction and over the span of a building's useful life (Wilson and Tagaza, 2006). The choice of construction materials has a significant impact on the health of building occupants and the environment. "Green" materials should be :

(1) reusable and recyclable;

(2) should have zero or low emissions and toxicity;

(3) should have high recycle potential, durability and longevity; and

(4) should have a greater flexibility under changing design requirements over the life of the building.

Life-cycle analysis of materials is required, according to Wilson and Tagaza (2006), to provide inventory and impact assessment of the materials and systems. Embodied energy studies are needed to assess the energy used by materials in its production, including mining, manufacture, transport, installation, maintenance and finally demolition.

2.3.11 Lack of skilled personnel. As stated earlier, the development of green building certification hinges on the availability of skilled and trained people to fill the emerging green jobs (Hammer *et al.*, 2012). According to International Labour Office (2011), shortage of skilled labour could shelve the plans for a green building. There is evidence that skill shortages already exist in certain green sectors around the world. Germany for instance

reports on lack of skilled solar photovoltaic (PV) technicians, while smart grid design engineers are in short supply in the UK. Solar technology installers and renewable energy technology project managers are needed in Spain and Denmark (European Centre for the Development of Vocational Training and International Labour Organisation, 2010). Demand for low-emission residential estates will require professionals with knowledge of building materials with low-embedded energy use. A report by Marsh (2009) identified that lack of experienced consultants and contractors with respect to green building projects results in schedule delays of the projects. Durmus-Pedini and Ashuri (2010) identified that contractors may lack the skills to properly implement green-oriented technology, and this could hinder the adoption of green buildings in any country.

3. Research methodology

3.1 Approach/strategy

This research followed a qualitative approach, as it systematically worked to solve the research problem and achieve the research aim. Qualitative approach was used because of the need to reveal existing knowledge in a way that could be expressed in the form of answers and so become accessible to interpretation (Flick, 2006). This approach further became necessary because the literature on green building adoption in Ghana is still at a nascent stage, and such qualitative approaches should be encouraged to obtain additional information on such issues. The research problem is: What barriers hinder the adoption of green certification of buildings in Ghana? To answer this research problem, an extensive literature review on barriers to green buildings and other related subjects was conducted to offer insight into the existing information.

3.2 Population and sampling

With this background on the potential barriers, a series of interviews was conducted with different industry experts from various professional bodies in the built environment in Ghana. These professional bodies formed the population for the study. The professional bodies were the Chartered Institute of Building – Ghana (CIOB – Ghana), Institution of Engineering and Technology – Ghana (IET), Ghana Real Estate Developers Association (GREDA), Ghana Institute of Planners (GhIP), Building and Road Research Institute (BRRI), Ghana Institute of Surveyors (GhIS), Association of Building and Civil Engineering Contractors of Ghana (ABCECG), Ghana Green Building Council (GhGBC), Ghana Institute of Architects (GIA) and Ghana Institute of Construction (GIOC).

The sample size for this study was ten elected members, one from each professional body. One member from each professional body was considered adequate to avoid duplication in responses from multiple professional members from the same professional body. The sample size of ten was considered to be good because, according to Parse (1990), for a qualitative study where researchers seek to obtain rich data, two-ten participants are recommended.

To further aid the professional bodies in selecting their representatives, the purposive sampling approach was used. This approach was deemed necessary because of the intention to select individuals that were well proficient and well informed about the subject matter. Following this, three selection criteria were proposed to the professional bodies to assist them in nominating their representatives:

(1) The interviewee was required to be a member of a professional body and to be someone who was in good standing.

(2) The professional body or interviewee was required to be knowledgeable on the concept of green building certification.

(3) The interviewee had to be willing to partake in the interview.

3.3 Design of interview guide

Face-to-face and telephonic interviews were organized around a semi-structured interview guide. The professional bodies were chosen because of the role they played in green buildings. A two-step procedure was followed to assess the appropriateness and rationality of the interview guide. A content-validity test was first conducted by referring to two researchers with in-depth knowledge about green buildings in the built environment. The researchers' comments helped in revising unclear and obscure questions by rewording them. Also, non-functioning and ineffective questions were discarded. The second step ensured the modification of the interview guide using the comments and suggestions from these researchers who had in-depth knowledge about the subject matter. The interview guide was given to the various professional bodies with an accompanying letter detailing the purpose of the study. The interview guide was distributed two weeks ahead of the planned interview schedule to offer these professional bodies the quality time to select an individual with knowledge on the subject matter. The interview guide was structured into two sections. The first section collected some background information of the respondents, and the second section sought the views of the respondents on the barriers to the adoption of green certification of buildings.

3.4 Thematic analysis of data

Data obtained were thematically analysed. Thematic analysis is a qualitative approach to examining research data, to understand and represent the experiences of people as they encounter, engage with and live those experiences (Elliot, 1999; Denzin and Lincoln, 2005). It is used to identify, analyse and report patterns or themes within data. Thematic analysis is a qualitative methodology that allows considerable freedom to researchers in their interpretation and selection of themes from the interview transcript.

Braun and Clarke (2006) provided procedural guidelines for conducting thematic analysis. The phases of thematic analysis are like the data-analysis process for the development of grounded theory (Charmaz, 2006) and involves familiarizing oneself with the data; generating initial codes; searching for themes; reviewing the themes; and defining and naming the themes. For the thematic analysis, the qualitative responses to the interview were coded using NVivo 11 Pro analysis application software. The coding involved the examination of interviewees' responses with the intention of grouping and "tagging" the responses with codes to facilitate later retrieval. Patton (2002) defines verbatim transcripts as "the undigested complexity of reality", needing classification to make sense of them. The responses were coded in nodes (themes) by identifying patterns in them. Node allowed the researchers to gather related material in one place to look for emerging patterns and ideas. From the data analysis, eight themes were generated, which comprise: lack of information on green buildings, lack of incentives, conservative nature of Ghanaians, lack of active government participation, inadequate human resource, lack of awareness of the benefits of green certification of building, cost and financing and lack of legal backing. These themes are discussed and supported by verbatim extracts from the data to highlight important issues. The interviewees were recorded using an audio recorder, and the data obtained were transcribed using MS Word 2016. The

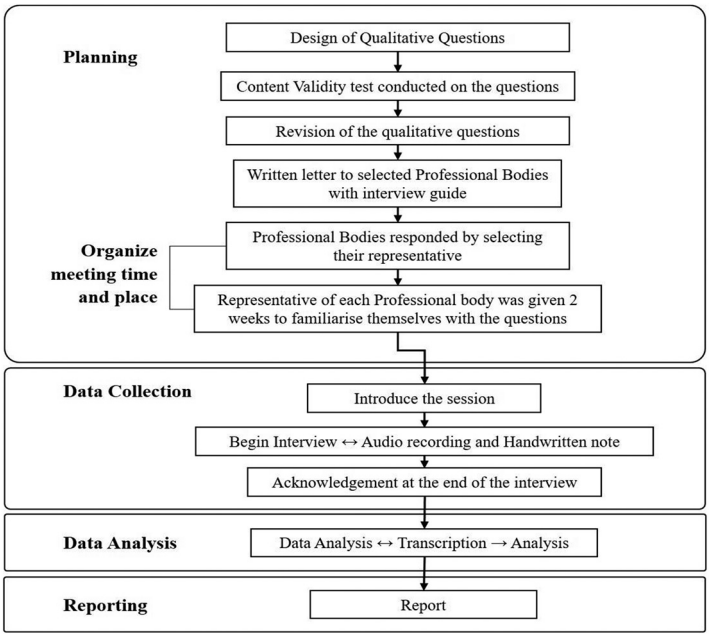
outcome of this research made it possible to achieve the aim of the research, which was to identify the barriers that hindered the adoption of green certification of buildings in Ghana.

The flow chart of the proposed methodology, that is, the steps taken in designing the research instrument through to how data were analysed, is shown in Figure 1. The various processes described in sub sections 3.1 to 3.4 have further been summarized in five phases, i.e. planning, organize meeting time and place, data collection, data analysis and reporting. The details under each phase are summarized in Figure 1.

4. Results and discussion

4.1 Demography of respondents

Table I presents a brief demographic background of the respondents. Respondents' professional body, positions in the professional body, years of working experiences and the interview mode are all presented. In all, ten respondents were interviewed – one interviewee was selected from each built environment professional body. For ease of interpretation, the various interviewees were given unique codes to represent the individual professional bodies. The codes ranged from PB 1 to PB 10, as indicated in Table I. Table I further shows that for the interviewees, the minimum number of years of working experience was 8, while the maximum was 45. Six out of the ten respondents were interviewed on the telephone after samples of the interview guides had been sent to them. The remaining four were interviewed face-to-face.



Source: Authors' own construct

Figure 1.
Flow chart for adopted methodology

Table I.
Information on interviewees

No.	Professional body	Code	Position in the professional body	Years of working experience	Mode of interview
1	CIOB-Ghana	PB 1	Member	8 years	Face-to-face
2	IET	PB 2	Member	8 years	Face-to-face
3	GREDA	PB 3	Secretary	18 years	Phone call
4	GhIP	PB 4	President	15 years	Phone call
5	BRRI	PB 5	Research assistant	20 years	Face-to-face
6	GhIS	PB 6	Council member	20 years	Phone call
7	ABCECG	PB 7	Member	45 years	Phone call
8	GhGBC	PB 8	Member	30 years	Phone call
9	GIA	PB 9	Member	25 years	Phone call
10	GIOC	PB 10	Member	15 years	Face-to-face

4.2 Results from the thematic analysis

As already stated, the eight themes generated from the analysis include: lack of information on green buildings, lack of incentives, conservative nature of Ghanaians, lack of active government participation, inadequate human resource, lack of awareness of the benefits of green certification of building, cost and financing and lack of legal backing. These themes have been expounded to include the following.

4.2.1 Theme 1: lack of legal backing. A key factor in facilitating the rate of adoption and implementation of green certification of buildings is the systematic imposition of legal regulations that ensure that individuals follow best practices. Several interviewees admitted that there was no legal enforcement in making them adopt green certification of buildings in Ghana. They believed that governments could play leading roles in green certification of buildings by enacting laws which stipulate professionals to incorporate certain aspects of the certifications in their products. The government has the mandate to set laws and regulations related to green buildings, which usually fall under a country's plan for strategic development. A typical instance was sighted by the respondents as:

> No legal backing to make it mandatory for people to certify their buildings to be green (PB 1, PB 5, PB 7 and PB 8).

Governments plays a significant role in the promotion of green buildings. They can set a number of regulations that favour energy conservation and energy efficiency, which makes the public obligated to follow green building principles (Mosly, 2015). At the same time, the reverse outcome can be realized when no attention is given to energy regulations. Enforcing regulations is essential for the success of government strategies; the absence of an enforcement body can threaten the realization of these strategies, which include new established regulations related to green buildings.

4.2.2 Theme 2: cost and financing. The fear for higher investment costs of green buildings compared to traditional buildings and the risks of unforeseen costs are among the most commonly addressed barriers for green buildings (Hakkinen and Belloni, 2011). Some respondents mentioned cost as a major barrier that could deter people from adopting green buildings. Some of the interviewees perceived that the cost of green buildings would be higher than conventional buildings. However, they suggested that financial institutions should have financial packages for those who would want to build green, just as the financial institutions have packages for weddings, insurance, educational plan and even funerals. Verbatim comments from some of the respondents include:

> Cost and financing are the biggest challenges in deciding to adopt the green certification of buildings, but special mortgage incentives as green building incentives can motivate people to adopt the green certification of buildings (PB 3, PB 6, PB 8).

The interviewees specifically touched upon the role of financial institutions in lending funds to green building projects. Chan *et al.* (2018) identified cost as a key sensitive barrier to the adoption of green building technologies in Ghana. Green building practitioners estimate that green material costs are 3-4 per cent higher than conventional material costs (ULI, 2002). In developed countries such as Canada and the USA, high initial cost of green buildings is considered a barrier. A typical scenario depicted by Hwang and Tan (2012) shows that compressed wheat board if used as a green substitute for traditional plywood can cost about ten times more. A study on greening campuses of higher education institutions found that people generally believed that green buildings incurred higher initial costs (Richardson and Lynes, 2007). Developers' importation of new technology from other countries also influences implementation costs (Iwaro and Mwasha, 2010). Lack of funding or financing difficulties are also financial barriers for green building systems (Lawrence *et al.*, 2005; Lidula *et al.*, 2007). Lenders do not provide special funds to support technologies for building development (Zhang and Wang, 2013). An important recommendation made by Chan *et al.* (2018) is to use successful green building projects to show the real cost and benefits of adopting green building technologies in the Ghanaian market.

4.2.3 Theme 3: inadequate awareness of the benefits of green certification of building. Without client and customer awareness of the potential benefits of green building certification system, it will be difficult for them to show interest and consequently demand for them (Darko and Chan, 2016). Some of the respondents pointed out that their various professional bodies had not sensitized them on the benefits of green buildings. Comments from the respondents were as follows:

> Lack of understanding on life cycle cost and benefits of green buildings and conventional building (PB 6, PB 8).

The meaning of awareness, according to Nduka and Ogunsanmi (2016), is to create a base audience for a product, service or issue. Umar and Khamidi (2012) suggested that advertisement on radio stations and TV, website development specifically for green building campaigns, media relations in terms of articles and news releases are key tools in sensitizing green buildings to the masses of people. Chigona and Licker (2008) asserted that abstract or ambiguous innovations were generally difficult to adopt, and that its diffusion became quite slow. The Ghanaian society can better appreciate green building certification if the benefits of adopting them are visible for the would-be adopters to know how feasible that is. An example is that companies will demand green buildings if it can be demonstrated that the superior indoor environment quality results in improvements to staff health, staff satisfaction and staff productivity (Wilson and Tagaza, 2006). Whang and Kim (2015) posited that the key to successful adoption of green building was people's awareness of its benefits. Opoku and Ahmed (2015) also recognized the importance of public awareness and proper knowledge and understanding of sustainability as being essential to the successful adoption of green buildings. Nigeria is also battling with low level of awareness as Alabi (2012) observed a low level of awareness of the concept of sustainability among construction participants in Nigeria. In Kuwait, Alsanad (2015) attributed the low implementation of green buildings to lack of awareness.

4.3.4 Theme 4: inadequate human resource. The development of green building certification hinges on the availability of skilled and trained people to fill the emerging green jobs (Hammer *et al.*, 2012). International Labour Office (2011) indicates that shortage of skilled labour could bring to a halt the green building movement. From the views of the interviewees, there are no certified green building professionals that are easily accessible in

Ghana. Training of staff is highly essential for the success of implementing new technology and software (Succar *et al.*, 2013). One interviewee verbally stated this as a major issue:

> Fear of inadequate trained assessors (PB 4).

The implementation of green building projects differs from that of traditional building projects not only in terms of processes, design and materials but also in terms of technologies involved. The allocation of funds for the training of professionals in green building from project managers to artisans would significantly assist in facilitating the adoption of green building in the construction industry (Hwang *et al.*, 2017). There is a need to have local certified green building professionals in the country as a means of building their capacity.

4.3.5 Theme 5: lack of active government participation. Koski and Lee (2014) identified governments as the most visible members of the regulated community and who are often scrutinized for their actions. The respondents were of the view that the government's involvement in green building projects gave legitimacy to the efforts of advocacy groups such as the Ghana Green Building Council. According to the respondents, they have not seen government participation in terms of certifying their public buildings, which sends a signal to them that the government is not interested. Sangster (2006) asserted that the government is frequently the largest owners of structures in a country. This should therefore create an opportunity for governments to be supportive of green buildings and encourage this type of development in any way. Implementing green buildings in their own way is a great way for governments to demonstrate leadership and environmental responsibility. Views of some respondents read:

> The government does not show enough commitment as we do not see any certified green government buildings (PB 1, PB 4, PB 7, PB 9).

The government should be aware that in the early stages of green building adoption, its guidance and support are essential for successful and widespread adoption (Chan *et al.*, 2017). This implies that the adoption of green building in a country is largely dependent on the government policies and regulations (Gou *et al.*, 2013; Zhang, 2015); therefore, the government must assume a more active role in the pursuit of implementing sustainability in the construction industry by developing policies and regulations to promote green building adoption.

4.3.6 Theme 6: conservative nature of Ghanaians. Some of the interviewees asserted that Ghanaians were acclimatized to the way they did their things on a normal basis. This becomes a barrier when an innovation is introduced; it becomes difficult to convince people to do away with what they are used to and accept something new. People in Ghana are accustomed to building in a certain way, and introducing new types of technologies and systems will not be immediately accepted. Resistance to change is part of Ghanaian culture, but there could be gradual acceptance over time through proven benefits of green buildings. Interviewees indicated this verbally as follows:

> Social acceptance of new technology like green certification of buildings (PB 2, PB 3).

4.3.7 Theme 7: lack of incentives. To encourage people to invest in green buildings, it is necessary to make these types of buildings attractive, which can be accomplished by providing incentives to those who build green. These incentives can take many forms (e.g. an exemption from certain service fees or an allowance for extra building area). At the current stage of green building adoption in Ghana, lack of government incentives is a major barrier to green building adoption (Chan *et al.*, 2018). The views of some respondents verbally expressed are:

> To my knowledge, government support for green buildings in the form of incentives does not exist; we need incentives. (PB 2, PB 5, PB 6, PB 7, PB9).

Some of the incentives that emerged from the interviews were:

> Tax rebates for contractors who construct green building projects should be instituted to encourage contractors to always bid for green building projects (PB 4, PB 6, PB 9, PB 10). Reduction of import duties on green building materials should also be instituted. (PB 1, PB 2, PB 3, PB 5, PB 7, PB 8,)

In Malaysia, the Government uses sequence of green tax immunity and diminution and incentive investment to improve green building integration in the private and public sectors (Aliagha *et al.*, 2013). Upon several studies over the years, it has been purported that green building incentives is still on the dwindle in most countries (Darko and Chan, 2016), and Ghana is no exception. The Government of Germany for instance provide incentives to promote green building by introducing tax credit portfolios and mechanisms for regulation while helping the implementation of other economic instruments (Lutzkendorf and Lorenz, 2006).

4.3.8 Theme 8: lack of information on existing green buildings. Currently in Ghana, there is no database with information on all the green buildings that exist. There is a need to have a database with green building projects as a source of information to also learn from it. This database can be linked to the various websites of the professional bodies in the built environment in Ghana. This system will ensure the easy availability of information, accurately shared among professional bodies to promote enhanced discussions among themselves. Not even the Ghana Green Building Council has these green buildings on their website. This depicts the difficulty for practitioners within the current construction industry in Ghana to find information and data relating to green buildings.

The interviewees provided the following comment:

> Lack of information and awareness on the current green buildings that we do have (PB 4, PB 5, PB 7, PB8, PB10).

Inadequate data on the use of green building valuation system is a barrier (Shi, 2009). When there is no easily accessible record for green materials and its products, which is very much needed for assessment, it drives people away from adopting after they have become aware of its benefits (Shi, 2009). According to Chang *et al.* (2015), lack of database and knowledge of green building certification systems are the main obstacles.

5. Conclusion and recommendations

The increased development of urbanization, environment and issues related to energy have increased the attention of the construction community to find more sustainable ways to do things. The promotion and implementation of the green certified buildings has become a primary theme of modern construction. However, the adoption of green certification of buildings in developing countries, specifically Ghana, is at its infancy because of the numerous barriers encountered in trying to implement this concept. This study adopted face-to-face and telephonic interviews, organized around a semi-structured interview guide, with built environment professionals to examine their views on the barriers to the adoption of green certification of buildings in Ghana. Data obtained were thematically analysed, and the findings revealed that eight barriers were key in the adoption. The barriers identified include *lack of information on green buildings, lack of incentives, conservative nature of Ghanaians, lack of active government participation, inadequate human resource, lack of awareness of the benefits, cost and financing* and *lack of legal backing*.

Unlike other studies, this study fills a necessary gap by allowing professionals directly involved in green certification of buildings to provide their verbatim comments on the potential barriers to the adoption of green buildings. In the context of a developing country such as

Ghana, this is crucial because some striking findings from this study, such as "inadequate awareness of the benefits of green certification of buildings", "inadequate human resource", "conservative nature of Ghanaians" and "lack of information on existing green buildings", should help advance knowledge on the existing potential barriers. These four barriers identified are unique in the context of this study. The findings of this study further contribute to the understanding of a few key barriers to the adoption of green certification of buildings in the context of a developing country. The findings are expected to contribute valuable information towards policy making, development of a suitable certification system for Ghana and the development of mechanisms to implement green building certification practices.

The interviewees identified a range of barriers. The identification of these barriers should provide a platform for further studies to be conducted to eliminate them or at least reduce their negative impact by setting suitable strategies. Though the objective set out in this study was achieved, the authors acknowledge the presence of some limitations. Because this research qualitatively explored the barriers to the adoption of green certification of buildings in Ghana through a series of interviews, with professionals in the built environment, different stakeholders may take part in a study that could follow a quantitative approach. Also, the findings obtained are largely dependent on the perspectives of few practitioners. Such perspectives as given on the subject matter by the practitioners may be limited. Future work can therefore involve a wider range of participants, with broader perspectives on the subject matter. This can be done through a quantitative approach with the aim to study green building opportunities in Ghana. In addition to addressing these limitations, future studies can look at purposively clustering the emergent themes developed in this study to enable a more comprehensive overview. Based on the findings of this study, the following recommendations are made for policymakers to assist in overcoming the identified barriers:

- *Recommendation 1*: Education and training must be intensified to improve the knowledge of both the private and public sectors about green certification of buildings.
- *Recommendation 2*: A green buildings database with information on the current green buildings in Ghana should be made available, which would be linked to the websites of the various professional bodies in the built environment.
- *Recommendation 3*:Post-occupancy financial benefits information that will improve the knowledge of green building features and financing should be gathered and analysed.
- *Recommendation 4*: Public buildings such as public school, community schools and district assembly halls should be upgraded to green buildings.
- *Recommendation 5*: Performance-linked incentives for compliance with green certification of buildings should be provided.
- *Recommendation 6*: Skills should be developed through capacity building and by certifying personnel and service providers for green buildings.
- *Recommendation 7*: There should be proper documentation and distribution of the requirements of green certification of buildings.

References

Adetunji, I., Price, A.D.F. and Fleming, P. (2008), "Achieving sustainability in the construction supply chain", *Engineering Sustainability*, Vol. 161 No. 3, pp. 161-172.

Alabi, A.A. (2012), "Comparative study of environmental sustainability in building construction in Nigeria and Malaysia", *Journal of Emerging Trends in Economics and Management Sciences*, Vol. 3 No. 6, pp. 951-961.

Aliagha, G.U., Hashim, M., Sanni, A.O. and Ali, K.N. (2013), "Review of green building demand factors for Malaysia", *Journal of Energy Technologies and Policies*, Vol. 3 No. 11, pp. 471-478.

Alshuwaikhat, H.M. and Abubakar, I. (2008), "An integrated approach to achieving campus sustainability: assessment of the current campus environmental management practices", *Journal of Cleaner Production*, Vol. 16 No. 16, pp. 1777-1785.

Amjad, R., Arif, G.M. and Irfan, M. (2012), "Preliminary study: explaining the ten-fold increase in remittances to Pakistan 2001-2012", (Working paper No. 86).

Ang, G., Groosman, M. and Scholten, N.P.M. (2005), "Dutch performance-based approach to building regulations and public procurement", *Building Research and Information*, Vol. 33 No. 2, pp. 107 -119.

Berry, S., Davidson, K. and Saman, W. (2013), "The impact of niche green developments in transforming the building sector: the case study of Lochiel Park", *Energy Policy*, Vol. 62, pp. 646-655.

Braun, V. and Clarke, V. (2006), "Using thematic analysis in psychology", *Qualitative Research in Psychology*, Vol. 3 No. 2, pp. 77-101.

BRE, Building Research Establishment Environmental Assessment Methodology BREEAM, (2016), available at: www.breeam.com (accessed 21 January 2019).

Buys, F. and Hurbissoon, R. (2011), "Green buildings: a Mauritian built environment stakeholders' perspective", *Acta Structila*, Vol. 18, pp. 81-101.

CASBEE, Comprehensive Assessment System for Built Environment Efficiency, (2016), available at: www.ibec.or.jp/CASBEE/english (accessed 19 January 2019).

Chan, A.P.C., Darko, A. and Ameyaw, E.E. (2017), "Strategies for promoting green building technologies adoption in the construction industry–an international study", *Sustainability*, Vol. 9 No. 6, p. 969.

Chan, A.P.C., Darko, A., Olanipekun, A.O. and Ameyaw, E.E. (2018), "Critical barriers to green building technologies adoption in developing countries: the case of Ghana", *Journal of Cleaner Production*, Vol. 172, pp. 1067-1079.

Chan, E., Qian, Q. and Lam, P. (2009), "The market for green building in developed Asian cities–the perspectives of building designers", *Energy Policy*, Vol. 37 No. 8, pp. 3061-3070.

Chandra, S.S. (2018), "Green construction: analysis on green and sustainable building techniques", *Civil Engineering Research Journal*, Vol. 4 No. 3, pp. 1-10.

Chang, A.A.P., Chu, B.T.J., Hwang, C.L. and Lin, C.J.D. (2015), "Study of scope of intelligent green building project management definition", *in Environmental Science and Information Application Technology: Proceedings of the 2014 5th International Conference on Environmental Science and Information Application Technology (ESIAT 2014)*, CRC Press, Hong Kong, pp. 7-8.

Charmaz, K. (2006), *Constructing Grounded Theory: A Practical Guide through Qualitative Analysis*, Sage Publications, London.

Chigona, W. and Licker, P. (2008), "Using diffusion of innovations framework to explain communal computing facilities adoption among the urban poor", *Information Technologies and International Development*, Vol. 4 No. 3, pp. 57-73.

Cidell, J. (2009), "Building green: the geography of LEED-certified buildings and professionals", *Professional Geography*, Vol. 61 No. 2, pp. 1-16.

Clevenger, C. (2008), "Leadership in energy and environmental design", available at: www.stanford.edu/class/cee115/wiki/uploads/Main/Schedule/LEED.pdf (accessed 29 October 2012).

Darko, A. and Chan, A.P.C. (2016), "Critical analysis of green building research trend in construction journals", *Habitat International*, Vol. 57, pp. 53-63.

Deane, M. (2008), "The builder's role in delivering sustainable tall buildings", *The Structural Design of Tall and Special Buildings*, Vol. 17 No. 5, pp. 869-880.

Deng, W., Yang, T., Tang, L. and Tang, Y.-T. (2018), "Barriers and policy recommendations for developing green buildings from local government perspective: a case study of Ningbo China", *Intelligent Buildings International*, Vol. 10 No. 2, pp. 61-77.

Denzin, N. and Lincoln, Y.S. (2005), *The SAGE Handbook of Qualitative Research*, 3rd ed. SAGE, London.

Department for Communities and Local Government: London (2007), "Building a green developed Asian cities – the perspectives of building designers", *Energy Policy*, Vol. 37 No. 8, pp. 3061-3070.

DGNB, Deutsche Gesellschaft für Nachhaltiges Bauen, (2016), available at: www.dgnb.de/en/ (accessed 15 January 2019).

DuBose, J.R., Bosch, S.J. and Pearce, A.R. (2007), "Analysis of state-wide green building policies", *Journal of Green Building*, Vol. 2 No. 2, pp. 161-177.

Durmus-Pedini, A. and Ashuri, B. (2010), "An overview of the benefits and risk factors of going green in existing buildings", *International Journal of Facility Management*, Vol. 1, pp. 1-15.

Elforgani, M.S. and Rahmat, I. (2010), "An investigation of factors influencing design team attributes in green buildings", *American Journal of Applied Sciences*, Vol. 7 No. 7, p. 976.

Elliot, J.A. (1999), *An Introduction to Sustainable Development*, (2nd ed.) Routledge, London.

EPA (2016), "US environmental protection agency definition of green building", available at: http://archive.epa.gov/greenbuilding/web/html/about.html (accessed 26 January 2019).

Flick, U. (2006), *An Introduction to Qualitative Research*, Sage, London.

GBCA (2016), "Green star, GBIG (green building information gateway)", available at: http://new.gbca.org.au/green-star/ (accessed 15 January 2019).

Gou, Z., Lau, S.S.Y. and Prasad, D. (2013), "Market readiness and policy implications for 814 green buildings: case study from Hong Kong", *Journal of Green Building*, Vol. 8 No. 2, p. 162815.

Gou, Z., Prasad, D. and Lau, S.S. (2013), "Are green buildings more satisfactory and comfortable?", *Habitat International*, Vol. 39, pp. 156-161.

Green Building Council Brazil (2012), "Brasil já tem as primeiras construcßões sustentáveis de", available at: www.gbcbrasil.org.br/?p=imprensa-detalhes&I=293 (accessed 21 February 2012).

Hakkinen, T. and Belloni, K. (2011), "Barriers and drivers for sustainable building", *Building Research and Information*, Vol. 39 No. 3, pp. 239-255.

Hammer, R.J., Edwards, J.S. and Tapinos, E. (2012), "Examining the strategy development process through the lens of complex adaptive systems theory", *Journal of the Operational Research Society*, Vol. 63 No. 7, pp. 909-919.

Hoffman, A.J. and Rebecca, H. (2008), "Overcoming the social and psychological barriers to green building", *Organization and Environment*, Vol. 21 No. 4, pp. 390-419.

Horman, M.J., Riley, D.R., Lapinski, A.R., Pulaski, M.H., Magent, C.S., Luo, Y. and Har, N. (2006), "Delivering green buildings: process improvement for sustainable construction", *Journal of Green Building*, Vol. 1 No. 1, pp. 123-140.

Hu, H., Geertman, S. and Hooimeijer, P. (2014), "The willingness to pay for green apartments: the case of Nanjing, China", *Urban Studies*, Vol. 51 No. 16, pp. 3459-3478.

Hwang, B.-G. and Tan, J.S. (2012), "Green building project management: obstacles and solutions for sustainable development", *Sustainable Development*, Vol. 20 No. 5, pp. 335-349.

Hwang, B.-G., Zhu, L. and Tan, J.S.H. (2017), "Green business park project management: 831 barriers and solutions for sustainable development", *Journal of Cleaner Production*, Vol. 153, pp. 209-219.

Hydes, K. and Creech, L. (2000), "Reducing mechanical equipment cost: the economics of green design", *Building Research and Information*, Vol. 28 No. 5-6, pp. 403-407.

International Labour Office (2011), "Study of occupational and skill needs in green building: Final report/international labour office", ILO Skills and Employability Department (EMP/SKILLS)-Geneva: ILO, available at: www.ilo.org/wcmsp5/groups/public/—ed. . .skills/. . ./wcms_166822.pdf

Iwaro, J. and Mwasha, A. (2010), "A review of building energy regulation and policy for energy conservation in developing countries", *Energy Policy*, Vol. 38 No. 12, pp. 7744-7755.

Kibert, C.J. (2008), *Sustainable Construction: green Building Design and Delivery*, John Wiley and Sons, Hoboken, NJ,

Koski, C. and Lee, T. (2014), "Policy by doing: formulation and adoption of policy through government leadership", *Policy Studies Journal*, Vol. 42 No. 1, pp. 30-54.

Larsson, N. and Clark, J. (2000), "Incremental costs within the design process for energy efficient buildings", *Building Research and Information*, Vol. 28 Nos 5/6, pp. 413-418.

Lawrence, T., Mullen, J., Noonan, D. and Enck, J. (2005), "Overcoming barriers to efficiency", *ASHRAE Journal*, Vol. 47 No. 9, pp. s40-s47.

Leber, R. (2017), "Ghana ridge hospital first LEED certified hospital in Africa", available at: http://greenbuildingnews.com/2017/04/12/ghana-ridge-hospital-first-leed-certified-hospital-africa/

Li, Y., Yang, L., He, B. and Zhao, D. (2014), "Green building in China: Needs great promotion", *Sustain. Cities*, Vol. 11, pp. 1-6.

Lidula, N., Mithulananathan, N., Ongsakul, W., Widjaya, C. and Henson, R. (2007), "ASEAN towards clean and sustainable energy: potentials, utilization and barriers", *Renewable Energy*, Vol. 32 No. 9, pp. 1441-1452.

Liu, J.Y., Low, S.P. and He, X. (2012), "Green practices in the Chinese building industry: drivers and impediments", *Journal of Technology Management in China*, Vol. 7 No. 1, pp. 50-63.

Lutzkendorf, T. and Lorenz, D. (2006), "Using an integrated performance approach in building assessment tools", *Building Research and Information*, Vol. 34 No. 4, pp. 334-356.

McGraw-Hill (2013), *World Green Building Trends; Smart Market Report*, New York, NY.

Marsh (2009), *Green Building: Assessing the Risks (No. Report No. MA9-10142)*, Marsh Incorporation, New York, NY.

Mosly, I. (2015), "Barriers to the diffusion and adoption of green buildings in Saudi Arabia", *Journal of Management and Sustainability*, Vol. 5 No. 4, p. 104.

Nduka, D.O. and Ogunsanmi, O.E. (2016), "Construction professionals' perception on green building awareness and accruable benefits in construction projects in Nigeria", *Covenant Journal of Research in the Built Environment*, Vol. 3 No. 2, pp. 30-52.

Opoku, A. and Ahmed, V. (2015), *Leadership and Sustainability in the Built Environment*, Taylor and Francis, London.

Ozolins, P.C. (2010), Assessing sustainability in developing country contexts: the applicability of green building rating systems to building design and construction in Madagascar and Tanzania, Doctoral dissertation.

Park, M., Hagishima, A., Tanimoto, J. and Chun, C. (2013), "Willingness to pay for improvements in environmental performance of residential buildings", *Building and Environment*, Vol. 60 No. 2, pp. 225-233.

Parse, R.R. (1990), "Parse's research methodology with an illustration of the lived experience of hope", *Nursing Science Quarterly*, Vol. 3 No. 1, pp. 9-17, doi: 10.1177/089431849000300106.

Patton, M.Q. (2002), *Qualitative Research and Evaluation Methods*, Sage, Thousand Oaks, CA.

Poon, C.S., Yu, A.T., Wong, A. and Yip, R. (2013), "Quantifying the impact of construction waste charging scheme on construction waste management in Hong Kong", *Journal of Construction Engineering and Management*, Vol. 139 No. 5, pp. 466-479.

Powmya, A. and Abidin, Z.N. (2014), "The challenges of green construction in Oman", *International Journal of Sustainable Construction Engineering and Technology*, Vol. 5 No. 1, pp. 33-41.

Redl, P. (2013), "Sustainable building certification – the case of hotel buildings", *Austria Research and Information*, Vol. 39 No. 3, pp. 239-255.

Richardson, G.R.A. and Lynes, J.K. (2007), "Institutional motivations and barriers to the construction of green buildings on campus: a case study of the university of waterloo, Ontario", *International Journal of Sustainability in Higher Education*, Vol. 8 No. 3, pp. 339-354.

Rohracher, H. (2001), "Managing the technological transition to sustainable construction of buildings: a socio-technical perspective", *Technology Analysis and Strategic Management*, pp. 137-150.

Rowlinson, S.M. (1988), "An analysis of factors affecting project performance in industrial building", PhD Thesis, Brunel University, Middlesex.

Saad, M.M. (2016), "Impediments to implementation of green buildings in South Africa", *9th CIDB Postgraduate Conference February 2-4, 2016, Cape Town, South Africa*.

Sangster, W. (2006), "Benchmark study on green buildings: Current policies and practices in leading green building nations", *Retrieved January*, Vol. 15, p. 2008.

Shapira, P., Goke, A., Evgeny Klochikhin, E. and Sensier, M. (2014), "Probing green industry enterprises in the UK: a new identification approach", *Technological Forecasting and Social Change*, Vol. 85, pp. 93-104.

Shi, Q. (2009), "Strategies of implementing a green building assessment system in mainland China", *Journal of Sustainable Development*, Vol. 1 No. 2, p. 13.

Shi, Q., Zuo, J., Huang, R., Huang, J. and Pullen, S. (2013), "Identifying the critical factors for green construction – an empirical study in China", *Habitat International*, Vol. 40, pp. 1-8.

Singh, C.S. (2018), "Green construction: analysis on green and sustainable building techniques", *Civil Engineering Research Journal*, Vol. 4 Vol. 3, p. 555638, doi: 10.19080/CERJ.2018.04.555638.

Smart Market Report (2016), "The dodge data and analytics world green building trends", available at: www.construction.com/news/study-finds-global-green-buildingexpected-to-double-2018-feb-2016

Sodagar, B. and Fieldson, R. (2008), "Towards a sustainable construction practice", *Construction Information Quarterly*, pp. 101-108.

Steinemann, A., Wargocki, P. and Rismanchi, B. (2017), "Ten questions concerning green buildings and indoor air quality", *Building and Environment*, Vol. 112, pp. 351-358.

Succar, B., Sher, W. and Williams, A. (2013), "2An integrated approach to BIM competency 929 assessment, acquisition and application", *Automation in Construction*, Vol. 35 No. 1, pp. 174-189.

Tagaza, E. and Wilson, J.L. (2004), "Green buildings: drivers and barriers e lessons learned from five Melbourne developments", *Report Prepared for Building Commission by University of Melbourne and Business Outlook and Evaluation*.

Tingley, D.D., & Davison, B. (2012), "Methodology to account for the environmental benefits of design for deconstruction", *Build Environ*, Vol. 57, pp. 387-395.

Turner, C. and Frankel, M. (2008), *Energy Performance of LEED for New Construction Buildings (Report): New Building Institute*.

ULI (2002), *Environment and Development: Myth and Fact*, Urban Land Institute, Washington, DC.

Umar, U.A. and Khamidi, M.F. (2012), "Determined the level of green building public awareness: application and strategies", *International Conference on Civil, Offshore and Environmental Engineering, Kuala Lumpur Malaysia*.

US Green Building Council (2016), "LEED v4 for building design and construction", available at: www.usgbc.org/resources/leed-v4-user-guide (accessed 5 January 2019).

Warren, P. and Taylor, P. (2008), "A comparison of occupant comfort and satisfaction between a green building and a conventional building", *Building and Environment*, Vol. 43 No. 11, pp. 1858-1870.

WCED, World Commission on Environment and Development. Our Common Future (1987), "(chapter 2): towards sustainable development", available www.un-documents.net/ocf-02.htm (accessed 26 January 2019).

Webster, C.B. and Dunn, B.C. (2011), "Creating a model of sustainability through the design, construction, and operations of a new high school", *Journal Green Build*, Vol. 6 No. 3, pp. 1-20.

Wei, W., Ramalho, O. and Mandin, C. (2015), "Indoor air quality requirements in green building certifications", *Building and Environment*, Vol. 92, pp. 10-19.

Whang, S. and Kim, S. (2015), "Balanced sustainable implementation in the construction industry: the perspective of Korean contractors", *Energy and Buildings*, pp. 9676-9685.

Wiafe, F. (2017), Factors Affecting the Implementation of Sustainable Construction in Ghana: the Architect's Perspective, (Master Thesis), Submitted to Kwame Nkrumah University of Science and Technology.

Wilson, J.L. and Tagaza, E. (2006), "Green buildings in Australia: drivers and barriers", *Australian Journal of Structural Engineering*, Vol. 7 No. 1, pp. 57-63.

Windapo, A. (2014), "Examination of green building drivers in the South African construction industry: Economics vs ecology", *Sustainability*, Vol. 6 No. 9, pp. 6088-6106.

Young, C.S. and Samson, D. (2008), "Project success and project team management: evidence from Capital projects in the process industries", *Journal of Operations Management*, Vol. 26 No. 6, pp. 749-766.

Zhang, X. (2015), "Green real estate development in China: State of art and prospect agenda – 971 a review", *Renewable and Sustainable Energy Reviews*, Vol. 47, pp. 1-13.

Zhang, Y. and Wang, Y. (2013), "Barriers' and policies' analysis of china's building energy efficiency", *Energy Policy*, Vol. 62 No. 11, pp. 768-773.

Zhang, X.L., Shen, L. and Wu, Y.Z. (2011), "Green strategy for gaining competitive advantage in housing development: a China study", *Journal of Cleaner Production*, Vol. 19 No. 2-3, pp. 157-167.

Zhang, X., Plattern, A. and Shen, L. (2011), "Green property development practice in China: costs and barriers", *Building and Environment*, Vol. 46 No. 11, pp. 2153-2160.

Zhou, L. and Lowe, D.J. (2003), "Economic challenges of sustainable construction", Engineering, Project Management Division, UMIST, Manchester, UK. Published by: The RICS Foundation. 2003. Proceedings of The RICS Foundation Construction and Building Research Conference 1st to 2nd September 2003. School of Engineering and the Built Environment, University of Wolverhampton. Pp. 113-126.

Zou, P. and Couani, P. (2012), "Managing risks in green supply chain", *Architectural Engineering and Design Management*, Vol. 8 No. 2, pp. 143-158.

Zuo, J. and Zhao, Z.Y. (2014), "Green building research–current status and future agenda: a review", *Renew. Sustain. Energy Rev*, Vol. 30, pp. 271-281.

Further reading

Aliagha, G.U. and Cin, N.Y. (2013), "Perceptions of Malaysia office workers on adoption of Japanese cool biz concept of energy conservation", *Journal of Asian and African Studies*, Vol. 48 No. 4, pp. 427-446.

Marshall, B., Cardon, P., Poddar, A. and Fontenot, R. (2013), "Does sample size matter in qualitative research? A review of qualitative interviews in IS research", *Journal of Computer Information Systems*, Vol. 54 No. 1, pp. 11-22.

Osei, E.A. (2015), "Sustainable building construction practices of Ghanaian building contractors", An MPhil dissertation Submitted to the Department of Building Technology, Kwame Nkrumah University of Science and Technology, Kumasi, Ghana.

Corresponding author

Kofi Agyekum can be contacted at: agyekum.kofi1@gmail.com