



Driving forces for green building technologies adoption in the construction industry: Ghanaian perspective



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ABSTRACT

As a response to mitigate various negative environmental effects of the construction industry, recent years have witnessed a growing interest in green building technologies (GBTs) adoption and development. Consequently, many studies have been conducted on the forces driving the GBTs adoption in different countries. However, there have been few studies identifying the driving forces (DFs) for GBTs adoption in developing countries such as Ghana. This study aims to identify the major DFs for GBTs adoption within the developing country of Ghana. To achieve the objective, 21 DFs were identified from a comprehensive literature review. Through a questionnaire survey with 43 professionals with green building experience, the results first indicated that “setting a standard for future design and construction”, “greater energy efficiency”, “improved occupants’ health and well-being”, “non-renewable resources conservation”, and “reduced whole lifecycle costs” were the top five forces driving the GBTs adoption. Further comparative analysis showed that the topmost rank of “setting a standard for future design and construction” is unique for GBTs adoption in only the developing country of Ghana, not in the developed country of the US. Additionally, factor analysis revealed that the underlying forces for the 16 significant DFs were environment-related, company-related, economy and health-related, cost and energy-related, and industry-related forces. This study improves understanding of the major DFs for GBTs adoption, providing a valuable reference for practitioners and policy makers to promote the wider adoption of GBTs. Future study will investigate the interrelationships between the significant DFs and their impacts on the GBTs adoption process. Future work is also required to employ a larger sample and investigate in greater detail the differences between the GBTs adoption DFs in Ghana and many other specific countries.

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1. Introduction

The construction industry consumes a great deal of energy and other natural resources and has a significant effect on the environment, economy, and society. In 2010, for example, the

construction industry was responsible for up to 32% of the total global energy consumption, 19% of the total global energy-related greenhouse gas (GHG) emissions, nearly one-third of the total global carbon emissions, and an eighth to a third of fluorinated gas (F-gas) emissions [69]. This energy consumption and the associated emissions might double or potentially even triple in the next centuries owing to several key trends (Intergovernmental Panel on Climate Change [32]. As a result of an increasing public concern on the negative impacts of construction activities in recent years, green or sustainable building development has attracted a growing attention from both the public and private sectors [16,72,73]. Green

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building is one of the measures introduced for implementing environmental, economic, and social sustainability in the construction industry. It is “the practice of creating structures and using processes that are environmentally responsible and resource-efficient throughout a building’s lifecycle” (US Environmental Protection Agency [58]. Green buildings are not only designed, built, and operated to have better environmental performance, but to also improve productivity and the health and well-being of occupants (U.S. Green Building Council [40,60].

It is urgent to implement green building through green building technologies (GBTs) adoption so that the detrimental environmental impacts of buildings can be reduced effectively. However, GBTs adoption and development is not free of barriers and difficulties. Barriers such as higher cost and a lack of knowledge and awareness affect GBTs adoption in the construction industry [12,67,68]. In light of these barriers, there are several forces that drive and shape the adoption of GBTs among construction practitioners and stakeholders in different countries and regions. A lot of research on forces driving GBTs adoption has been done (e.g., [4,17,37]. In spite of the existence of numerous studies on the driving forces (DFs) for GBTs adoption, such studies within the context of developing countries are rarely reported in the literature. A recent review study by Ref. [19] indicated that very few studies have attempted to analyze factors driving the adoption of GBTs in developing countries. In this light, the objective of this study is to identify the major DFs for GBTs adoption in the construction industry with reference to the developing country of Ghana. This study is important first because, given the limited number of studies examining GBTs adoption DFs in developing countries, its empirical findings add significantly to the existing green building literature. Moreover, this study improves understanding of the relevant DFs for GBTs adoption, which is necessary for guiding the GBTs adoption decision making of the industrial practitioners. Furthermore, the research findings also help policy makers and advocates identify key DFs that can be widely promoted in society to encourage the widespread adoption of GBTs to ultimately achieve the sustainable buildings development.

The remainder of the paper is organized into the following four main sections. A review of relevant literature is provided in section 2, followed by a brief overview of the present situation of GBTs adoption in Ghana. In section 3, a detailed description of the research methodology is presented. Section 4 presents and discusses the results of the study. The study is then concluded in section 5.

2. Literature review on GBTs adoption DFs

GBTs are defined as technologies – such as green roof and wall technologies, solar system technology, and prefabricated concrete technology – that are incorporated into building design and construction to make the end product sustainable [3,67,68]. The DFs also refer to the persuasions that encourage the adoption of GBTs, and can be broadly defined to encompass both the benefits of adopting GBTs and actions (such as policy initiatives) outside the benefits that lead people to take part in GBTs adoption [19]. It should be clarified that the research presented in this paper forms the second phase of a much larger research study on the promotion of GBTs adoption in a developing country in which only the benefits of GBTs adoption are treated as DFs and the actions outside the benefits are reasonably treated as promotion strategies. Because of the word/space limitation, this paper is only able to present the outcomes about the DFs. The future research paper will present the outcomes on the promotion strategies that form the fourth phase of the aforesaid larger study.

A review of relevant published literature was conducted to

identify the DFs for GBTs adoption. A summary of the analysis of the literature is shown in Table 1. For a more comprehensive review of the literature concerning the DFs for GBTs and practices adoption, the reader is referred to [19]. As Table 1 indicates, 21 typical DFs for GBTs adoption were identified from the literature review. Table 1 also shows the number of times each of the identified DFs was mentioned in the sampled/analyzed literature to indicate the attention it has attracted. These DFs can motivate the adoption of GBTs [17] and therefore a better understanding of them would play a crucial role in promoting the wider adoption of GBTs in Ghana. Detailed descriptions of the DFs can be found in the analysis results and discussion section.

2.1. A brief overview of the present GBTs adoption situation in Ghana

In order to help better understand the context within which this research was conducted, a brief overview of the present situation of GBTs adoption in Ghana is presented in this section. The adoption of GBTs in Ghana is slow and still in its infancy stage. The Ghana Green Building Council (GHGBC), which is the main organization to help advance GBTs adoption in Ghana, was only recently established in 2009 [24]. However, Ghana is among the few developing countries that are trying to achieve major progresses in GBTs adoption and development. For example, Ghana has successfully launched the first green commercial office building in West Africa, which is the One Airport Square, and Africa’s first LEED-certified hospital, which is the Ridge Hospital. In terms of policy, albeit there exist no governmental policies and regulations for mandating GBTs adoption in building developments in Ghana at the moment, the Ghanaian government still aims to promote GBTs use. In 2007, for instance, with the advice of the Energy Commission of Ghana (ECG), the government took the initiative to procure and distribute six million energy-efficient compact fluorescent lamps (CFLs) for free as a direct replacement of six million traditional incandescent lamps [21]. This was an initiative toward dealing with the 2007 energy crisis in Ghana. Another important action by the government was the introduction of Ghana’s Sustainable Development Action Plan in 2009 [6], which focuses on sustainable production and consumption programs that will manage scarce resources utilization to enable both the present and future generations to thrive. This is closely related to and supports GBTs adoption in construction projects in Ghana. This study can be helpful to relevant Ghanaian government departments in their efforts to further motivate GBTs adoption. Green building rating systems – systems for measuring green building performance – are also considered effective instruments for leading the construction industry towards GBTs adoption. Presently, there are two primary rating systems applied in Ghana: the Green Star of South Africa (Green Star SA) and the Leadership in Energy and Environmental Design of the US (LEED). The GHGBC is nowadays still in the process of developing a localized green building rating system for Ghana. In line with this, in 2012, the council launched the Eco-Communities National Framework which is “a vision, set of guided principles, and aspirations serving as the basis for the development of the rating system for communities, neighborhood, and cities development in Ghana” [25].

In Ghana, the private and commercial sectors have seen most of the GBTs implementations. That is, GBTs have been implemented in commercial office buildings that are mainly owned by individual organizations (e.g., private developers) rather than government (public) bodies. This situation could be attributed to the lack of policies and authoritative green building rating systems in Ghana [20] to mandate the application of GBTs in government-funded projects. In the Ghanaian residential sector, although some

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