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Barriers to successful implementation of sustainable construction in the Ghanaian construction industry

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Abstract

Sustainable construction efforts in some countries have been unsuccessful due to numerous barriers to its successful implementation. This study identifies and priorities likely barriers to successful implementation of sustainable construction in the Ghanaian construction industry and measures to overcome potential barriers. A multiple research approach involving semi-structured interviews and a questionnaire survey was adopted for the study. Interviews were carried out amongst purposively selected 18 contractors and 16 consultants whereas questionnaire survey was conducted among 100 randomly selected practitioners (58 Architects, 37 Quantity Surveyors and 5 Structural Engineers) to examine the relevance of the identified factors in the Ghanaian context. The factors identified as barriers to successful implementation of sustainable construction and measures to overcome potential barriers to sustainable construction were evaluated and ranked according to their mean scores. The five strongest barriers to the implementation of sustainable construction in Ghana are ranked as cultural change resistance, lack of government commitment, fear of higher investment costs, lack of professional knowledge, and lack of legislation respectively. Factor analysis using the SPSS Version 16 package enabled the barriers identified to be grouped under six components as 1) Financial barriers, 2) Political barriers, 3) Management/ Leadership barriers, 4) Technical barriers, 5) Socio-cultural barriers, 6) Knowledge/ Awareness barriers. The results of this study would enable the Ghanaian construction industry to be successful in its quest to implement sustainable construction. This will be possible through the implementation of the measures suggested to remove potential barriers to the implementation of sustainable construction. Identification of barriers and measures to overcome potential barriers are steps towards successful implementation of the sustainability concept in the Ghanaian construction industry.

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Keywords: Barriers; Sustainability; Sustainable construction; Construction industry; Ghana

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1. Introduction

The building industry is often described as an industry that is unfriendly and unkind to the natural environment [1]. A number of scholars have expressed concern about the continued destruction and enormous impact of the construction industry on the environment [2, 3]. Nevertheless, to deal with this situation, sustainable construction (SC) has emerged as a guiding paradigm to create a new kind of built environment: one that meets the needs of humans in the present without limiting the ability of future generations to meet their own needs. The SC concept has been introduced mostly in developed countries while less attention has been given to the concept in developing countries, where Ghana is no exception.

Sustainable construction is a cross-cutting issue and means different things to different persons. The review of related works shows multiple definitions exist [1, 2] and there is discrepancy in terms of scope and context. For straightforwardness, sustainable construction is best described as the subdivision of sustainable development and its application to the construction industry. The construction industry involves all who plan, develop, produce, design, modify or maintain the built environment and includes manufacturers and suppliers of construction materials, clients, contractors, consultants and end users of facilities [4]. Therefore, sustainable construction could be best described as a subset of sustainable development, which encloses matters such as tendering, site planning and organization, material selection, recycling, and waste minimization [2]. Sustainable construction is defined by some researchers as a construction process which integrates the fundamental themes of sustainable development [5, 6]. Such construction processes would hence bring benefits such as environmental responsibility, social awareness, and economic profitability to society at large [2, 3].

Sustainable construction has become a focal point for countries worldwide, as the earth's resources are under severe pressure due to increase in population and economic expansion. As a result of this, most nations are striving to implement sustainable construction practices in their various construction industries. Accordingly global interest on sustainability is progressively thriving, thus Ghana should not fell short in its stance on sustainable construction. Ghana needs to demonstrate that it can abide by this new interest and can compete in the global market. Due to the virtues and the growing interest of sustainable construction, it is incumbent on all stakeholders in the construction industry to identify the barriers that stand in the way of its implementation and subsequently come up with measures to overcome the potential barriers. It is against this backdrop that this research identifies and prioritises possible barriers to successful implementation of sustainable construction in the Ghanaian construction industry and measures to overcome potential barriers.

2. Research methodology

To identify and prioritise influential barriers and measures to overcome potential barriers to successful implementation of SC in the Ghanaian construction industry, a thorough review of the literature was conducted. Thirty-One barriers and eleven measures were identified [7, 8, 9, 10, 11]. Since the barriers and measures gathered from the literature had been sufficiently tested and used in similar studies in other countries, they were used as basis for the present study. A multiple research approach involving semi-structured interviews and a questionnaire survey was adopted for the study. Interviews were carried out prior to the questionnaire survey to examine the relevance of the identified factors in the Ghanaian context. Practitioners specifically architects, quantity surveyors (QS) and structural engineers (SE) registered with their various professional bodies and some consultants and contractors in the construction industry were involved in the study. The research adopted practitioners registered with the professional bodies due to lack of list of practitioners within the construction industry in Ghana. Architects, QSs and SEs were used for the reason that they were the only practitioners within the construction industry in Ghana who have recognized professional bodies i.e. Ghana institution of Engineers (GhIE), Ghana institution of surveyors (GhIS) and Architect Registration Council of Ghana (ARCG).

Consultants and Contractors were involved in the interview. They were purposively selected to ensure organisations that can be accessed and were willing to provide the needed information were consulted for the interview. The semi-structured interviews were conducted among 18 Contractors and 16 consultants. For the questionnaire survey, stratified sampling technique was employed in the selection of the three groups of practitioners. The three groups of practitioners i.e. architects, QSs, and SEs were employed as the strata in

stratification to allow for a proportional representation of practitioners across board. Simple random method was then employed in selecting the practitioners within the various strata to avoid researcher biases in the selection. Available records indicated that the ARCG had 333 architects, the GhIS had 75 quantity surveyors [12] and the GhIE had 5 structural engineers [12]. A sample size of 100 practitioners was determined using the following formula recommended for such studies by Yamane (1967). $n = \frac{N}{1+N(e)^2}$; Where: n = sample size, N = population size, e = desired level of precision (±5%).

The questionnaire used in this research was in three sections: Section 'A', 'B' and 'C'. Section 'A' sought to investigate background of the respondents. Section 'B' assessed the potential barriers in successful implementation of SC while section 'C' evaluated measures to overcome the potential barriers to successful implementation of SC in the Ghanaian construction industry The questionnaire prepared adopted closed-ended questions but options were given for respondents to add to the list of possible answers. The respondents were asked to score the severity of the 31 potential barriers to the implementation of SC on the Likert scale of 1 to 5 where 1 = 'Not severe' and 5 = 'Very severe'. The eleven measures to overcome potential barriers were also scored on a scale of 1 to 5, where 1 = 'Highly unimportant' and 5 = 'Highly important'. Each questionnaire was administered through a face-to-face session which ensured that 86 questionnaires out of the 100 were returned complete and used in the analysis, representing a response rate of 86%. The semi-structured interview was conducted before the questionnaire survey. In the course of the interview, two contractors declined to participate in the interview session with one though granting the interview, not allowing it to be audio recorded as was done for the remaining contractors. The interviews did not have specific time frames though on the average it took about thirty minutes. This approach was adopted to allow the interviewer to explore the views of the interviewee, allow them to explain their views on the subject matter make recommendations and suggestions and make room for the discussion of other pertinent issues not covered in the interview guide.

Data gathered was subjected to descriptive statistics and factor analysis using SPSS version 16 package. Factor analysis is a statistical technique used to identify a relatively small number of factors that explain observed correlations among variables [13]. It is primarily used for data reduction or structure detection with the assumptions that the variables are continuous, normally distributed, have a good linear relation between them and have underlying factors responsible for the observed correlation. Factor analysis is used when people have been measured on several continuous variables and it is wished to see whether these variables can be reduced to a smaller set of variables (Chris, 2004). It can also be used to identify any set of variables that correlate well with each other but less well with other items. It can be used to reduce a large number of correlated variables to a more manageable number of independent factors that can then be used in subsequent analysis [13].

3. Results and discussions

3.1. Barriers to implementation of SC

The barriers identified from literature and corroborated by industry practitioners were ranked according to their Mean Item Score (MIS) and Standard Deviations (SD). The results from the empirical analysis revealed that the five strongest barriers to implementation of SC in Ghana are cultural change resistance (MIS=4.78; SD=0.763), lack of government commitment (MIS=4.73; SD=0.711), fear of higher investment costs (MIS=4.69; SD=0.784), lack of professional knowledge (MIS=4.65; SD=0.823), and lack of legislation respectively (MIS=4.61; SD=0.842). The weakest barriers include lack of system knowledge (MIS=3.72; SD=0.882), lack of market segmentation (MIS=3.69; SD=0.816), lack of employees training and development (MIS=3.66; SD=0.682) and delay in decision making (MIS=3.57; SD=0.963) among others. Cultural change resistance has been documented as a major barrier of SC. This change resistance results in a lack of demand by clients and stakeholders of construction projects affecting its eventual supply. Williams and Dair (2006) in equal vain identified lack of sustainability measures by stakeholders as by far the most commonly recorded barrier and further stated the lack of demand by the client as a commonly recognized barrier. This barrier was also cited as the most significant barrier by eighty-four per cent (84%) of respondents as a construction project cannot be done along sustainable lines without the owner or developer's "full support for sustainable concepts" (Ibid). The success of sustainable construction is highly dependent on the desire of

stakeholders in the construction industry to be committed to change and working towards congruent goals and objectives. The effect of lack of government commitment on the implementation of SC in Ghana confirms results from literature [8]. Sustainable construction cannot be successfully implemented without the commitment of government. Since government is a key stakeholder in the industry, it has to play a major role such as providing the enabling environment for effective implementation of SC. The effect of fear of higher investment costs on the implementation of sustainable construction has also been well documented [7, 10, 11]. According to Häkkinen and Belloni [7], the fear of higher investment costs for sustainable buildings compared with traditional building and the risks of unforeseen costs are often addressed as barriers for sustainable buildings. Hydes and Creech [11] opined that these perceived higher costs may be as a result of increases in the consultant's fees and indirectly from the unfamiliarity of the design team and contractors with sustainable construction methods. Though it is a famous fact that sustainable practices in construction are estimated to increase initial capital cost normally in the range of 1 – 25%, this is counterbalanced by humongous savings in the operational costs (Kats & Capital, 2003) and user comfort.

On the contrary, prospective clients are more often than not not aware of these savings. However, if life-cycle cost philosophy is seriously put into practice, developers and clients will realize and appreciate the benefits. Sustainability will not only reduce life-cycle cost but also increase productivity of employees using the building (Kats & Capital, 2003). Lack of professional knowledge has also been recognized as a grave challenge in SC implementation. Rydin et al. [9] claim that while designers display confidence in their ability to access and utilize knowledge in all-purpose, this confidence falls when sustainable construction issues are addressed. This presumes that professionals within the built environment need to be copiously familiar with sustainable construction principles in order to effectively implement its practice. Apart from that they also need to form an integrated professional team right from conception to the closure stages of construction projects. This team needs to have the best available information on products and tools to achieve sustainable construction. However, Williams and Dair [14] identified that that was not the case at present.

The results of the factor analysis carried out on the potential barriers to implementation of SC was based on the criteria that a factor is deemed to be significant to the study if it has a mean value of 2.50 or more. Since all the 31 factors have mean rating of more than 3.50, they were included in the factor analysis. All the 31 factors had communalities of 1.00, indicating their appropriateness for the factor analysis. The 31 significant factors were further reduced to common factor patterns. This was done to empirically explain the potential barriers to the implementation of SC in the Ghanaian construction industry. In doing this, principal component analysis with Varimax rotation and Kaizer Normalisation was used to determine which factors have empirical significance. Factor retention was by the eigenvalue 1.0 criterion, suggesting that only factors that account for variances greater than one should be included in the factor extraction. The principal component analysis where linear combinations of observed variables are formed, was the method used to extract the factors. The first principal component is the combination that accounts for the largest amount of variance and the second principal component accounts for the next largest amount of variance and is uncorrelated with the first. It was found that Component 1 has total variance of 8.201, which accounts for 41.227% of the total variance of the 31 factors. Component 2 has total variance of 2.457 accounting for 6.232% of the total variance of the 31 factors. Component 3 has a total variance of 2.043 accounting for 4.835% of the total variance of the 31 factors. Component 4 has a total variance of 1.432 accounting for 4.524% of the total variance of 31 factors. Component 5 has a total variance of 0.993 accounting for 3.276% of the total variance of 31 factors and Component 6 has a total variance of 0.934 accounting for 3.011% of the total variance of 31 factors. These six components constitute 63.105% of the total variance of the 31 factors. From the 31 factors identified from the literature as potential barriers to implementation of SC, and then confirmed through meetings with practitioners, factor analysis enabled 27 of these significant barriers to be placed under six components as follows:

- **Component 1**: Fear of higher investment costs, fear of long Pay-back period, client worries in profitability, ignorance of life cycle cost, and lack of financial resources.
- **Component 2:** Lack of government policies/support, lack of building codes on sustainability, lack of government commitment, and lack of legislation.

- **Component 3:** Lack of leadership, lack of market segmentation, lack of motivation and aspiration values of managers, and delay in decision making.
- **Component 4:** Lack of environmentally sustainable materials, lack of sustainability measurement tools, lack of exemplar 'demonstration project', lack of easily accessible guidance, lack of technical ability, and chronic skills and labour shortages.
- **Component 5:** Lack of demand for sustainable products and cultural change resistance.
- **Component 6:** Lack of awareness of professionals, lack of professional knowledge, lack of awareness of clients, lack of awareness of benefits, ignorance or misunderstanding about sustainability and lack of education and knowledge in sustainable design.

Based on the examination of inherent relationships among the factors under each component, the following interpretations were made to explain the underlining phenomenon linking the factors.

3.2. Component 1: Financial barriers

The influence of financial barriers on the implementation of SC has been well recognized [7, 10, 11]. This component identified fear of higher investment costs, fear of long Pay-back period, client worries in profitability, ignorance of life cycle cost, lack of financial resources as major barriers to the implementation of sustainable construction. The additional financial cost of providing measures to improve the sustainability of construction works has been cited by many researchers as being a major barrier to the realisation of SC concept. Though it is documented that the long-term benefit is worth the initial increase in investment, the perceived long-term benefits are normally not expressed in terms of financial return but focused instead on the environmental and social benefits that the developer believed the technology or methodology could deliver.

3.3. Component 2: Political barriers

The effect of political barriers on the success of implementation of SC has also been well documented [15, 8, 9, 10, 11]. This component identified lack of government policies/support, lack of building codes on sustainability, lack of government commitment, and lack of legislation. Dadzie and Dzokoto [15] posited that SC concept would be successful if stakeholders especially government put in place legislation that will require cooperate sustainability policies and also the development of various policy documents to enforce sustainability in all aspects of their development. The success of SC is highly reliant on the commitment of government and the formation of legislation. Due to the many benefits associated with sustainable design and construction, governments and their agencies should lead the crusade by progressively incorporating sustainable design and construction practices into new construction projects so that private organizations and individuals can emulate [15].

3.4. Component 3: Management/leadership barriers

The effect of good management and leadership on the success of SC has been well documented [8, 9, 10, 11]. This component identified Lack of leadership, Lack of market segmentation, Lack of motivation and aspiration values of managers, Delay in decision making as barriers to implementation of SC. The management and leadership of the construction industry and individual organisations have a major role to play in achieving successful implementation of innovative strategies [8]. The success of sustainable construction implementation lies in the commitment of managers and leaders in developing and implementing an effective plan and adequately providing the required resources and support to manage changes arising from the implementation [8]. Without the support and innovative management and leadership in implementing the SC concept, the concept implementation may face numerous difficulties.

3.5. Component 4: Technical barriers

The effect of technical barriers on the success of SC has been well documented [8, 9, 10, 11]. This component identified lack of environmentally sustainable materials, lack of sustainability measurement tools, lack of exemplar 'demonstration project', lack of easily accessible guidance, lack of technical ability, chronic skills and labour shortages as the major barriers to the implementation of sustainable construction. These barriers are considered technical because they have a direct impact on the success of implementation of sustainable construction principles. Rydin et al. [9] asserted that designers in the construction industry are not confident when the issues of sustainable construction design arise. This presupposes that professionals within the built environment need to be fully acquainted with sustainable construction principles in order to implement its practice. According to Osaily [8], the availability of locally sourced 'green' building products, such as advanced glazing systems etc, proved difficult for many sustainable construction projects. Products had to be imported from elsewhere in many cases, either directly by the project team or through a locally approved distributor. A lack of appropriate guidance appeared to exist for designers in the implementation of sustainable construction projects. It is important that technical information on sustainable construction is made available to design professionals in an appropriate format, and to the contractors ultimately responsible for implementing the design. Access to such information at an affordable rate was cited as a barrier to the use of such techniques by Osaily [8].

3.6. Component 5: Socio-cultural barriers

The effect of socio-cultural barriers on the success of SC implementation has also been well reported in the literature [15, 8, 9, 10, 11]. The Ghanaian construction industry has operated in a particular style for a long period of time as such it presents itself as a sector which is traditionally very difficult to change especially with respect to construction methods practiced and building materials used. This change resistance results in a lack of demand for sustainable products by clients and stakeholders. Williams and Dair [14] stated lack of demand of sustainable products by the client as a commonly recognized barrier. This barrier was also cited as the most significant barrier by eighty-four per cent (84%) of respondents as a building project cannot be done along sustainable lines without the owner or developer's "full support for sustainable concepts" [14].This component identified lack of demand for sustainable products, cultural change resistance as the major barriers to implementation of SC.

3.7. Component 6: Knowledge/awareness barriers

The impact of good awareness and knowledge on the success of SC implementation has been reported in the literature [7, 14]. This component identified lack of awareness of professionals, lack of professional knowledge, lack of awareness of clients, lack of awareness of benefits, ignorance or misunderstanding about sustainability, lack of education and knowledge in sustainable design as the major barriers to implementation of SC. Häkkinen and Belloni [7] stated that sustainable construction can be hindered by ignorance or a lack of common understanding about sustainability. Williams and Dair [14] identified in their study that evidence of hindrance due to a lack of information was an experience common to most stakeholder groups in the construction industry. In several cases, stakeholders admitted to not being aware of sustainable measures or alternatives that fall within their remit. Similarly, installing sustainable technologies and materials requires new forms of competencies and knowledge, yet it was evident from the research that not all those with responsibilities in this area had the necessary experience or expertise to meet the challenge [14]. The construction industry is made up of different actors with different opinions (clients, consultants and contractors) who have to come and work together as a team in order to ensure the successful completion of a project. There is therefore the need to create and improve awareness and knowledge of SC amongst the various actors in the construction industry in Ghana.

3.8. Measures to overcome prospective barriers to implementation of SC

The respondents were asked to evaluate the 11 measures that could overcome potential barriers to implementation of SC, identified from literature and confirmed through interviews with some contractors and consultants in the Ghanaian construction industry. From the mean scores, standard deviations and rankings of the 11 measures, it was found that all 11 measures have mean ratings more than 4.00 and therefore were considered significant. The results show that the five most significant measures to overcome potential barriers to implementation of SC in the Ghanaian construction industry are 'Government with the support of stakeholders in the construction industry should come up with special legislations, codes or standards relating to sustainable construction practices', 'Discussions, seminars, training, and workshops on sustainable construction and its importance should be initiated by stakeholders in the industry', 'Need for fiscal incentives', 'Devote funding for sustainable construction development ' and 'Creation of awareness'. A greater level of collaboration between the government, employers, professional bodies and training providers is essential to promote a learning culture within the construction industry, and to ensure that the training provided supports the changing needs of the industry and its clients. It is essential that this be backed up by a commitment to continuous professional development (CPD) that allows for the effective dissemination of innovation and best practice. The research by Barlow [16], concerning the self-build market, demonstrates that even with awareness of the implications of design decisions with regard to sustainability issues, and with the best will to implement more sustainable methodologies, the additional capital cost of 'green construction' still remains an effective barrier to the uptake of these technologies and methods.

There is, therefore, a need for government intervention to create the appropriate fiscal measures that allows sustainable housing construction to compete with conventional construction on cost. This would help to generate greater demand and stimulate the economies of scale that would eventually favour more sustainable construction technologies and processes. Furthermore, local government needs to understand that the pivotal role that they play in the planning process gives them an ideal opportunity to promote sustainable development. Supplementary Planning Guidance should be put in place in each local authority area to raise awareness of the practical issues surrounding sustainable construction, and this should be used as an opportunity to join up the policies affecting different areas of their work such as Highways, Housing, Waste, Energy Conservation, and Environmental Health. Local authority officers should be able to provide guidance to local developers and contractors on how they can assist the central government in achieving the essential social, economic and environmental aims of sustainable development.

4. Conclusion and recommendations

From 31 factors identified by the construction practitioners as potential barriers to the implementation of SC, factor analysis enabled 27 of them to be placed under six components: 1) Financial barriers comprising fear of higher investment costs, fear of long Pay-back period, client worries in profitability, ignorance of life cycle cost, and lack of financial resources; 2) Political barriers comprising lack of government policies/support, lack of building codes on sustainability, lack of government commitment, and lack of legislation; 3) Management/ Leadership barriers comprising lack of leadership, lack of market segmentation, lack of motivation and aspiration values of managers, and delay in decision making; 4) Technical barriers comprising lack of environmentally sustainable materials, lack of sustainability measurement tools, lack of exemplar 'demonstration project', lack of easily accessible guidance, lack of technical ability, and chronic skills and labour shortages; 5) Socio-cultural barriers comprising lack of demand for sustainable products and cultural change resistance; 6) Knowledge/ Awareness barriers comprising lack of awareness of professionals, lack of professional knowledge, lack of awareness of clients, lack of awareness of benefits, ignorance or misunderstanding about sustainability and lack of education and knowledge in sustainable design. To ensure the successful implementation of sustainable construction, Government with the support of stakeholders in the construction industry should come up with special legislations, codes or standards relating to sustainable construction practices, Discussions, seminars, training, and workshops on sustainable construction and its importance should be initiated by stakeholders in the industry, there is the need for government to introduce some fiscal incentives. Government agencies on their part should embark on applicable

policies that could provide critical support to make sustainable construction feasible. The identified barriers and measures to overcome potential barriers to implementation of SC should provide an enabling environment for construction practitioners to successfully implement sustainable construction and improve construction sustainability for the benefit of society at large.

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