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Sustainable building processes' challenges and strategies: The relative important index approach

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ABSTRACT

Sustainability has been increasingly advocated by the global construction industry due to the need to minimise the industry's adverse impacts. An important area when focusing on sustainability is the issue of project management teams since they are involved from the project's inception to its completion. Many studies have investigated and advocated a wide range of sustainability practices within the construction industry. However, little attention has been geared towards construction project management teams when addressing the issues of sustainability. This study aims to provide an empirical analysis of the challenges and mitigating strategies for enhancing project management teams' readiness in the adoption of sustainable building processes. It does so by undertaking an extensive critical review of literature resulting in the identification of sixteen challenges and sixteen mitigation strategies and conducted a cross-sectional survey among 200 Ghanaian construction industry professionals. Data obtained from the survey was analysed using descriptive statistics and relative importance index rankings. The study revealed that inadequate training and education, unfamiliarity with green technologies, and higher initial costs of green construction practices and materials are the key challenges that hinder project management teams' implementation of sustainable building processes. The study further revealed the significant mitigation strategies such as educating stakeholders on the future benefits of green buildings, engaging personnel with green building background, and setting sustainable priorities and goals early in the feasibility study. The value of this paper is to help project management teams to understand these challenges and strategize to turn them into opportunities for the construction industry.

1. Introduction

Sustainability has become a catchy word for both researchers and industry practitioners. Ferro et al. (2017) indicated that sustainability involves environmental, economic and social issues that transcends organisational boundaries, and it is significantly relevant to the organisation's operations. Review of several sustainability literature highlights the fact that more attention has been geared towards the environmental aspect since it serves as the foundation for the other aspects of sustainability (Obringer and Nateghi, 2021). A key area when considering environmental sustainability is sustainable construction.

Sustainable construction is an approach widely sought by governments, environmentalists and other stakeholder groups who recognise its benefits (Kibert, 2016). Globally, an approximate number of 171 countries have now set up their environmental management systems and frameworks through ISO 14000 to solve environmental issues resulting from greenhouse gas emissions (Tam et al., 2019). With the global population expected to increase to almost 9.8 billion by 2050 (United Nations Department of Economics and Social Affairs, UNDESA, 2017), there is a high probability that there would be a surge in the demand for energy, raw materials, and other resources.

However, understanding the sustainable building processes in the construction industry is at its infant stage of research which requires further exploration and study (SBCI, 2009). For instance, the concept of sustainable building process is a new notion in developing countries such as Ghana and is hardly practised by the construction firms in the

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country (Darko et al., 2018). Samari et al. (2013) opined that despite the creation of an eco-community national framework by the Ghana Green Building Council, the adoption of sustainable building processes and its development is still largely unexplored in the Ghanaian construction industry (GCI).

To improve the adoption of sustainable building processes, Hwang and Tan (2012) were of the view that project management teams could enhance and promote sustainable building processes since they are recognised as key actors in the construction industry who ensure that project objectives are met and delivered successfully. Also, project management teams could adopt basic sustainability goals throughout the building processes (Roe, 2012; Hills et al., 2008). The basic goals of sustainability for the construction industry as postulated by Kubba (2010) consists of reducing energy consumption, safeguarding the ecosystem, enhancing the health of occupiers, and improving productivity. The project management team can incorporate these objectives into their roles during the planning, designing and construction phases of building projects to ensure that these basic sustainable goals are met.

Several studies have been conducted to improve the understanding and need to explore the benefits of sustainable building processes for the construction industry of developing countries. For example, understanding green certification and its implementation in the GCI (Agyekum et al., 2019); appreciating the key drivers of environmental sustainability in construction (Opoku et al., 2019a), and adopting green building technologies in buildings (Darko et al., 2018). Studies have also been conducted to broaden the knowledge base of the construction industry on sustainable practices such as considering the barriers of environmental sustainability (Opoku et al., 2019b); implementing green certification process in buildings (Ampratwum et al., 2019) and understanding how organisations could perform in sustainable-led construction projects (Mensah et al., 2014). However, irrespective of the existing studies, the empirical evidence of understanding project management teams' readiness in enhancing sustainable building processes could improve the adoption and implementation of the concept in developing countries' construction industry.

Therefore, this study provides an empirical analysis of the challenges and mitigating strategies for enhancing project management teams' readiness in the adoption of sustainable building processes in the GCI. The study aims to achieve its objective by addressing (i) the challenges encountered by project management teams in managing sustainable building processes; (ii) examining the strategies to be adopted for solving the challenging factors of sustainable building processes.

This study contributes to the knowledge of sustainable building processes by first expanding the literature base on the challenges confronting project management teams in adopting sustainable building processes (section 2) and identifying the mitigating strategies for overcoming the challenges in the sustainable building process. The methodology adopted for the study and tools used for analysis are elaborated in section 3 of this paper which explains the questionnaires in details and elucidates on the participants responses in the survey. The results and discussions are presented in section 4 while the conclusions from the study are shown in section 5.

2. Literature review

2.1. Sustainability

Sustainability concept suggests a positioning between merging future and present needs and assisting with the different issues that radiate from long term and short-term management of structures, organisations and resources (Kubba, 2010). Opoku et al. (2019a), in defining sustainable construction, emphasised that it is an infrastructure project or development that meets the desires of the present without compromising the ability of future generations to meet their own needs.

Construction in most developing countries such as Ghana relies heavily on traditional methods, which makes the use of advanced techniques more challenging and stressful. Client and major stakeholders often abhor innovative methods of construction, which is a major barrier in the achievement of sustainable construction (Tokbolat et al., 2020; AlSanad 2015). Though Djokoto et al. (2014) reported in their study that the construction industry has a desire for sustainable construction. The study also stressed on the inability of contractors to implement sustainable practices. Asamoah and Decardi-Nelson (2014) and Pham et al. (2020) opined that the construction industry in most developing countries is reluctant to exceed the requirements of the client, making the industry very sophisticated to operate. Most clients will only endorse a sustainable construction practice if it falls within the conventional construction procedures (Iqbal et al., 2021).

Opoku et al. (2019b) and Ampadu-Asiamah and Ampadu-Asiamah (2013) emphasised that construction professionals also lack adequate training on sustainable construction principles. Djokoto et al. (2014) identified ten key challenges to sustainable construction namely: low client demand for sustainable construction practices, inadequate sustainable development strategies, high cost of sustainable practices, public ignorance of the essence of sustainable practices, lack of support from the government, lack of cooperation, high risk of investment, lack of appropriate building regulations, high initial cost of investment and a lack of appropriate tools for measuring sustainable construction.

The adoption of sustainable construction by the construction industry could reduce the environmental impact of a built asset throughout its whole lifecycle and lead to the attainment of sustainable national development (Hossain et al., 2020; Opoku and Ahmed, 2014). Extant studies indicates that the built environment significantly affects the living standards of the people and therefore makes the industry a key determiner of sustainable national development (Antwi-Afari et al., 2021; Yu et al., 2021).

2.2. Project management teams

Kendall (2016) opined that most successes of construction projects are made possible at faster rates when project management teams exist in the construction project. Project management is the process of controlling the achievement of the objectives (specific objectives) of a project (Association for Project Management, 2019). Kerzner (2014) emphasised that project management is the field of initiating, planning, executing, controlling, and finalising the work of a team to achieve specific goals and the project success criteria.

According to Wu and Low (2010), technical-related issues such as ensuring energy efficiency, quality of construction and using less harmful materials in the building process have gained more attention in the sustainable building process. Nonetheless, non-technical related issues such as human behavioural attributes are mostly overlooked by project management teams during implementation of total quality management in construction processes and sustainable building processes.

However, to achieve the goals of green construction, the project management team needs to plan and achieve several criteria such as the attaining sustainable development throughout the project life cycle; realising client and other stakeholders' satisfaction without compromising sustainable practices which should be the key underlying goal; including measures to accomplish the aims of green building such as good record keeping and sourcing the right materials throughout the project life cycle (Wu and Low, 2010).

Shi et al. (2012) asserted that during sustainable construction the project management team should focus on activities quite different from their usual practice (e.g., technologies) and other normal processes such as management of stakeholders and structuring of the organisation. To ensure the success of sustainable building projects, all members of the project management teams must perform their duties accordingly. For instance, the civil engineer must facilitate sustainable project planning which could result in obtaining better sustainable outcomes for the project (Guix et al., 2019; Beheiry et al., 2006). Also, to hasten decision

making at the planning stage when selecting the requisite construction materials and technologies in relation to achieving the sustainability goals, contractors and suppliers need to identify the environmental consequences of construction works, equipment and materials through a feasibility study (He et al., 2019; Shen et al., 2010). The key role of the project management team in a sustainable building process is to focus on sustainable construction objectives, organisational relationship between parties, technical detail design, and the systematic process and procedures for the sustainable management of the project (Silvius and de Graaf, 2019; Shi et al., 2012).

2.3. Project management teams' challenges in sustainable building processes

An extensive review of the literature was conducted and the potential project management teams' challenges in sustainable building processes were identified. Some of the key challenges identified form the extant review are higher costs of sustainable building processes and materials; construction process technicalities; long bureaucratic processes; unfamiliarity with sustainable technology; inadequate awareness; and lack of sustainable product information.

2.3.1. Higher costs of sustainable building processes and materials

The estimated cost for sustainable building ranges from 1% to 25% more than conventional building (Dwaikat and Ali, 2016; Wang et al., 2010). The higher cost is a result of the complexity of the design layout coupled with modelling and green practices (Wu et al., 2019). The use of sustainable building materials cost 3–4% more than using traditional building materials (Zhang et al., 2011a,b). The exorbitant expenses of sustainable building affect the project management team since they will be accountable for dealing with and handing over their initiatives within a pre-set budget.

2.3.2. Construction process technicalities

The processes involved in the construction of sustainable buildings could be overly complex as they may be associated with complicated technologies and construction procedures (Wu et al., 2019). When the complexities in the construction processes are not communicated early, the overall performance of the project management team could be compromised. Notwithstanding, to achieve the stipulated objectives of a project, project management teams must implement project management systems effectively (Robichaud and Anantatmula, 2011).

2.3.3. Long bureaucratic processes

Graeber (2015) reported that the bureaucratic process for accepting the use of new and modern technologies in construction projects could increase the project completion time. Zhang et al. (2011a,b) also outlined the lengthy approval processes which management must go through to seek acceptance of the construction processes for their projects. This lengthy approval poses many challenges, especially to the management of the project.

2.3.4. Unfamiliarity with sustainable technology

Silvius et al. (2012) explained that project management teams appear to have very little knowledge about sustainable construction materials and processes. Darko et al. (2018) emphasised that unfamiliarity with sustainable technologies adversely affects the overall project outcome and performance. Project management teams should ensure that actual performance does not deviate from planned performance (Barbosa et al., 2021).

2.3.5. Inadequate awareness

The conventional notion of how a building must be constructed exists, but many builders do not want to engage in sustainable construction because of the perceived risks (Kibert, 2016). Environmental auditing adoption which is a beneficial sustainable building practice is mostly not done because of lack of understanding (Agyekum et al., 2019). There is also inadequate public education concerning the advantages of sustainable construction because of the paucity in sustainability studies, specifically on issues concerning indoor environmental condition, productiveness, and health of occupants (Darko, 2019). Opoku et al. (2019b) postulated that this lack of awareness is a major challenge associated with sustainable building processes.

2.3.6. Lack of sustainable product information

Lack of sustainable product information concerning sustainable materials and sustainable construction process which needs to be understood in sustainable buildings constitute a challenge for project management teams (Schöggl et al., 2017; Häkkinen and Belloni, 2011). Builders are continually compelled to interact with specialists who have such knowledge. Other identified challenges are risks due to the different contract forms of project delivery (Koolwijk et al., 2018), communication and the interests of project team members and more time needed to enforce sustainable building processes on construction sites.

2.4. Strategies to manage the challenges of sustainable building processes

Wu and Low (2010) stated that several challenges exist when construction is ongoing; the longer time it takes to construct, and the increased activities involved could have a significant effect on the environment. However, several strategies could be put in place to manage these challenges. Hwang and Tan (2010) affirmed that adopting sustainable construction practices and green building methods could mitigate these challenges. Nevertheless, project management teams face several challenges in adopting sustainable building processes. For example, safety management has monetary expenditure implications (Li et al., 2019a, 2019b), which will increase the cost of sustainability. Arditi (2009) outlined several strategies that could help individuals to appreciate sustainable construction and building processes.

3. Research methodology

An extensive literature review was conducted to identify the potential challenges and strategies to mitigate the challenges of sustainable building processes. The literature review provided a theoretical basis to underpin the study and laid the foundation for developing the survey questionnaire. In addition, the study adopted a quantitative approach to achieve the research objectives.

The variables obtained from the literature review were strategically embedded into closed-ended questionnaires. The structured questionnaire was organised in two parts. Part one considered the respondent profile while part two delved into the challenges and the mitigating strategies to overcome the challenges faced by project management teams in implementing sustainable budling processes. A five-point Likert scale ranging from 'Strongly Disagree = 1 to Strongly Agree = 5 was employed on the variables in Part Two of the questionnaire. The five-point Likert scale was used in this study since it has an advantage of providing results that are unambiguous and easy to interpret (Ekanayake and Ofori, 2004).

Before the questionnaires were administered, a two-step piloting procedure was used to access its appropriateness for the intended purpose. First, an international expert in sustainable building processes with 10 years working experience was employed to consider the construction and wording of the questionnaire to ensure that it was free of ambiguous expressions and that right terms were used. Second, in the piloting process, interviews were conducted with 15 industry players (Architects, Engineers, Quantity Surveyors, and Project Managers) within the construction industry who had experience in sustainable building processes within the Ghanaian context. These professionals also had to check the suitability of the questions asked and figure out if to the best of their knowledge any challenges and strategies have been

omitted. The professionals gave some encouraging feedbacks which resulted in the merging of some of the challenges and strategies. Following these feedbacks, the two-part questionnaire was finalized and sent out. Similar piloting had been used in other sustainable building-related studies (Chan et al., 2017; Zhao et al., 2015).

The population of the study included professionals (i.e., Building Consultants and Contractors) in Ghana. Respondents within the Building Contractors category were selected from Class D1 building contractors. Also, respondents within the Consultants group were selected from the Ghana Institute of Architects (GIA), Ghana Institute of Surveyors (GhIS), and the Institution of Engineering and Technology Ghana (IETG). The selection of respondents was dependent on the respondents' possession of adequate knowledge and expertise in sustainable construction.

There were difficulties in obtaining the exact number of D1 building contractors in Ghana, so the non-probability sampling techniques were used. The non-probability sampling technique could be used to arrive at a representative sample (Antwi-Afari et al., 2018; Zhao et al., 2015; Patton, 2001). Wilkins (2011) opined that non-probability sampling techniques could be used when it is not possible to use a random sampling method to select respondents from the population, but rather the willingness of the respondents to participate in the study. Purposive and snowball sampling techniques were used in this study to arrive at an effective and valid overall sample size. Several studies such as Owusu-Manu et al. (2018); Mao et al. (2015); Zhang et al., 2011a,b have also used these techniques in construction engineering and management related studies. Based on the sampling techniques, a total of 50 questionnaires were administered to D1 building contractors.

Within the Ghana Institute of Architects, 760 members were identified to be of good standing based on the list available. Out of this number 130 were identified through the purposive and snowball sampling techniques to be working with various consultancy firms and with knowledge concerning sustainable construction. All the 130 respondents were invited to partake in the survey.

The Ghana Institute of Surveyors include members with different backgrounds such as valuation and estate surveying division, land surveying division, and quantity surveying division. Based on required information, professionals within the quantity surveying division were selected and sampled for the study. The records of the Ghana Institute of Surveyors indicate that 387 quantity surveyors are working with various consultancy firms and are in good standing with the institution. Adopting purposive and snowball sampling techniques, 120 respondents were identified to meet the criteria and were invited for the survey.

The Institution of Engineering and Technology Ghana is a professional body made up of professional members with all engineering backgrounds. For the purposes of this study, those members (i.e., civil, and building) who fell within the boundaries of this study were considered. Within the institution, 52 construction professionals, 15 civil engineering professionals, and 16 building engineering professionals are registered with various consultancy firms and are in good standing. Using purposive and snowball sampling techniques, 30 of these members (i.e., civil and building) who were in good standing based on the list available were invited to partake in the survey.

A total of 330 questionnaires were administered (280 to building consultants and 50 to D1 building contractors) and 200 questionnaires with valid responses were returned, corresponding to a response rate of 60.61%. This response rate was possible because of the personal identification of these professionals.

The questionnaire data were analysed using IBM SPSS v22. The five-point Likert scale was transformed into relative importance indices (RII) using the relative index ranking technique priorities to rank the challenges and strategies as perceived by the respondents in the study (Gambo and Gomez, 2015). RII was calculated based on the following equation: RII $= \sum$ W/A x N, where W is the weighting given to each factor by respondents ranging from (1–5), N is the total number of respondents, $\sum$ is the total frequency in the sample and A is the highest weight (5 in this case). From the equation above, the RII values obtained ranged from 0 to 1.

4. Results and discussions

A total of 200 professionals from building construction and consultancy firms in Ghana were involved in the study. Adopting descriptive statistics on the demographic section of the questionnaires it was revealed that 31.0% of the respondents were Quantity Surveyors, 25.0% were Architects, 23.0% were Project Engineers, and 21.0% were Project Managers. Majority of the respondents were master's degree holders (62.5%) and bachelor's degree holders (24.5%) respectively. In addition, more than half of the respondents had over 10 years of working experience. This information shows that the respondents were knowledgeable enough to provide meaningful information required for the study.

4.1. Data normality test

Prior to the analysis, the Cronbach's Alpha Test was conducted to check the internal consistency of the scale used for the rating of the various challenges and strategies. A score of 0.70 and above shows the scale being used for the rating is internally consistent (Bonett and Wright, 2014). The result of this test was 0.853 which means there was reliability with the Likert scale used to rate the challenges and strategies. As many statistical tests require a normal distribution of the data (Kim, 2015), the Shapiro-Wilk test was used first to test the data normality (Ferretti et al., 2017; Hsu et al., 2000). The null hypothesis of the Shapiro-Wilk test is that 'the data were normally distributed'. The common alpha value, which tested normality (i.e., 0.05), was used in conducting the Shapiro-Wilk test. If the p-value produced by the test is lower than the selected alpha value, then the null hypothesis should be rejected, and we may conclude that the data are not normally distributed (see Table 1).

In this study, all the p-values produced by the Shapiro-Wilk test were lower than .05 (Tables 2 and 3), indicating that the data collected are not normally distributed. This is an expected result since data collected from samples that are not very large are usually not normally distributed (Hwang et al., 2017; Shan et al., 2017). The non-normal distribution of the data influenced the selection of statistical tests for analysing the data.

4.2. Inter-group comparison

Since the respondents were drawn from different professional backgrounds (i.e., Architects, Engineers, Quantity Surveyors, and Project Managers), it was important to check the significant differences between them by conducting an inter-group comparison (Shan et al., 2017).

To conduct an inter-group comparison, two dissimilar statistical

Table 1
Challenges and Strategies in sustainable construction and building processes.

Challenges	Strategies
Environmental impact	• Implementation of environmental improvement system • Implementation of effective waste management systems • Ensuring energy efficiency at the various workplaces
Cost-saving	• The adoption of the right construction techniques that could help avoid unnecessary cost
Health and safety	• Implementing healthy and safety management systems
Physical resources	• The adoption of effective storage management systems. • The use of just-in-time scheduling
Training and education	• Regular conferences for instructing inexperienced constructing practices and targets for all website online workforces • Education and training periods for subcontractor's development

Source: Arditi (2009)

Table 2
Challenges faced by Project Management Teams in sustainable building processes.

Challenges	Total	SD	RII	Rank	p-value	p-value
Inadequate training and education	200	0.882	0.856	1	.000[a]	.647[b]
Unfamiliarity with green technologies	200	0.667	0.822	2	.000[a]	.474[b]
Higher initial costs of green construction practices and materials	200	1.013	0.789	3	.000[a]	.175[b]
Slow tendering and procurement processes	200	1.194	0.789	4	.000[a]	.312[b]
Unaddressed health and safety issues	200	1.330	0.789	5	.000[a]	.828[b]
Inappropriate policies and instruments for steering sustainable development	200	0.937	0.783	6	.000[a]	
More time required implementing sustainable building process on site	200	1.326	0.778	7	.000[a]	.364[b]
Lack of awareness	200	1.199	0.772	8	.000[a]	.272[b]
Lack of communication among project team members	200	1.130	0.750	9	.000[a]	.216[b]
Long process phases and scheduling of tasks	200	1.095	0.733	10	.000[a]	.539[b]
Risk due to different contract forms of project delivery	200	1.204	0.717	11	.001[a]	.764[b]
Lengthy approval process for new green technologies and recycled materials	200	1.230	0.711	12	.002[a]	.604[b]
Technical difficulty during the construction process	200	0.845	0.694	13	.000[a]	.695[b]
Demand and the role of clients	200	1.334	0.672	14	.000[a]	.120[b]
Difficulty in obtaining the required material resources	200	1.261	0.661	15	.002[a]	.327[b]
Lack of sustainable product information	200	1.085	0.656	16	.006[a]	.415[b]

Note: SD = Standard deviation. [a] The Shapiro-Wilk test result is significant at the significance level of 0.05 (p-value < .05). [b] The Kruskal-Wallis H test result is significant at the significance level of 0.05 (p-value < .05).
Source: Field data

techniques could be employed, namely, analysis of variance (ANOVA) and Kruskal-Wallis H test. ANOVA is a commonly applied parametric test for checking differences between mean scores from three or more groups; it has an assumption that the population from which the sample was drawn is normally distributed (Pallant, 2013). As a non-parametric alternative to ANOVA, the Kruskal-Wallis H test, on the contrary, does not have any stringent requirements; it also does not make any assumption about the underlying distribution of the population (Pallant, 2013; Field, 2013). Therefore, owing to the non-normal distribution of the data, the Kruskal-Wallis H test was chosen over ANOVA for the inter-group comparison in this study (Tables 2 and 3).

4.3. Project management teams' challenges in sustainable building processes

In Table 2, the variables were ranked based on their RII values. Where two or more variables have the same RII values, the variable with the least standard deviation was ranked higher (Ahadzie, 2007). From the analysis, lack of training and education was ranked first with an RII of 0.856. Unfamiliarity with green building technology was ranked second with an RII of 0.822 while the higher cost of green construction practices and materials ranked third with an RII of 0.789.

Table 3
Mitigating strategies for enhancing project management teams' readiness in sustainable building processes.

Mitigating Strategies	Total	SD	RII	Rank	p-value	p-valve
Educating stakeholders on the future benefits of green buildings	200	0.899	0.872	1	.000[a]	.399[b]
Engaging personnel with green building background	200	1.072	0.844	2	.000[a]	.469[b]
Setting sustainable priorities and goals early in feasibility study	200	1.079	0.817	3	.000[a]	.496[b]
Establishing basic communication procedures	200	1.014	0.800	4	.000[a]	.626[b]
Careful choice of building methods	200	0.999	0.794	5	.000[a]	.731[b]
Conducting planning and strategy meetings	200	0.950	0.778	6	.000[a]	.242[b]
Implementing health and safety management system	200	1.142	0.761	7	.000[a]	.768[b]
Interest free lending	200	0.920	0.761	8	.001[a]	.249[b]
Conduct toll-box meeting regularly	200	1.150	0.756	9	.000[a]	.221[b]
Regular meetings	200	0.906	0.750	10	.000[a]	.158[b]
Government to provide incentives	200	1.531	0.744	11	.000[a]	.467[b]
Conducting charrette to establishing basic communication	200	0.980	0.739	12	.000[a]	.190[b]
Public and market demand for green buildings	200	0.920	0.739	13	.000[a]	.261[b]
Insistence from client	200	1.132	0.689	14	.001[a]	.664[b]
Subsidy from government	200	1.178	0.678	15	.001[a]	.389[b]
Bonuses provided for staff	200	1.222	0.672	16	.002[a]	.111[b]

Source: Field data.
Note: SD = Standard deviation. [a] The Shapiro-Wilk test result is significant at the significance level of 0.05 (p-value < .05). [b] The Kruskal-Wallis H test result is significant at the significance level of 0.05 (p-value < .05).

4.3.1. Inadequate training and education

The implementation of every practice in the built environment is dependent on the amount of information available to the responsible parties as a result of training and education. Sustainability in the GCI is a relatively new phenomenon and most practitioners have not acquired the requisite knowledge and training to equip them with the skills needed for its implementation. Based on this there is the need to educate these professionals about sustainable building processes. This is feasible if the professionals adhere to the recommendations presented by Chan et al. (2018) regarding the need to develop a comprehensive national sustainability database to professionals with accurate and updated information regarding sustainable building processes. Robichaud et al. (2011) asserted that the implementation of sustainable building processes is dependent on the amount of training and education that construction professionals obtain. The implementation of the requisite training and education could help project management teams to select proper designs and construction materials which would ensure sustainability and circularity of materials at end-of-life (Sauvé et al., 2016). In a similar study, Samari et al. (2013) was of the view that the lack of professional knowledge and training act as a barrier to the implementation of sustainable building processes in developing countries. Project management teams in most developing country appears to have little understanding of sustainable building processes (Silvius et al., 2012).

4.3.2. Unfamiliarity with green building technologies

Zhang et al. (2011) opined that a project management team is required to perform according to the requirement of the project

owner/client. However, when project management teams are unfamiliar with the technologies used for attaining green building, performance outcome could be affected. The modern technologies used in attaining sustainability are complex and requires project management teams to be abreast with them to ensure their implementation (Wu et al., 2019). The inability of project management teams to understand how these new technologies and tools such as Building Information Modelling, artificial intelligence, internet of things, and virtual reality operate can hinder the project management teams' ability to achieve sustainable building performance (Silvius et al., 2012). The existence of little knowledge in operating the requisite tools and technologies to ensure sustainable building is a major challenge which needs to be addressed to enhance project management teams' readiness in sustainable building processes (Darko et al., 2018). Shi et al. (2013) also indicated that industry associations could share relevant sustainable project information and its benefits among its members to boost their desire to implement these practices.

4.3.3. Higher initial costs of green construction practices and materials

Sustainability is a concept that requires a long-term view to appreciate its cost benefits where considerations must be given to the initial cost and the ongoing costs of the project. In the long term, the cost benefits of sustainable construction can be realised, but the initial capital outlay in constructing a sustainable building is high regardless of the substantial building processes adopted (Wu et al., 2019). Dwaikat and Ali (2016) and Dobson et al. (2013) argued that there exists a lag in the extent to which sustainable practices are implemented by the project management teams to enhance the sustainable performance of buildings. This lag was attributed to the view held by clients and other stakeholders on the initial cost of green construction. Most stakeholders do not appreciate the need to spend high amount of money on sustainable building processes when traditional methods of construction in comparative nature are costing less (Hwang and Tan, 2012). It therefore becomes a challenge to the project management team to convince clients and stakeholders of the ensuing benefits of adopting sustainable building processes. The higher initial cost of green construction practices then becomes a key barrier to implementing sustainable building processes and a challenge to the project management teams which influences their readiness to engage in sustainable building processes in the first place (Zhang et al., 2011a,b). This corroborates with a study by Chan et al. (2017) in which one of the key challenges to the implementation of sustainable building processes in developing countries was identified as the concern of cost of green construction.

4.4. Mitigating strategies for enhancing project management teams' readiness in sustainable building processes

Ahadzie (2007) was of the view that variables with indices greater than 0.700 should be considered as keen and having tremendous impact on the measured dimension. Therefore, inferring from Table 3, it could be deduced that educating owners on the future benefit of green building was ranked first by the experts of the survey with an RII of 0.872. Engaging personnel with green building background was also ranked second with an RII of 0.844 while setting sustainable priorities and goals early in feasibility study was ranked third by the respondents with an RII of 0.817. Inspecting Table 3 further, all the variables from 4th to 13th had indices greater than 0.700, showing their importance as key strategies to overcome the challenges faced by project management teams in sustainable building processes in the GCI context.

4.4.1. Educating stakeholders on the future benefits of green buildings

To mitigate the challenges faced by project management teams in implementing sustainable building processes in the GCI, it was identified that educating stakeholders on the future benefits of green buildings could enhance the implementation of the concept irrespective of the high initial cost (Opoku et al., 2019a). Simpeh and Smallwood (2015) indicated that there is lack of information regarding the full benefits that sustainable practices can offer especially in developing countries and this hinders their willingness to invest in such practices. The experts ranked this variable high because it could envisage that owners understanding of sustainable building process could have rebound effects in influencing the designs they agree on by project management teams during the early stages of the project. Wu et al. (2019) opined that training and educating stakeholders would reduce the challenge of project management teams in convincing stakeholders to undertake green and sustainable building processes.

4.4.2. Engaging personnel with green building background

The complexities and cost implications of sustainable building process requires that experts with backgrounds in green building are consulted from the beginning of the construction project (Wu et al., 2019). Nduka and Sotumbo (2014) highlighted that investing sustainable buildings present benefits to the buyers and consumers, and also present opportunities to other stakeholders in the industry. The experts of the survey also agreed that project management teams would have less challenges when they are working with a team of experts who understand sustainable building processes and have a green building background. Such a team of experts could bring their nonpareil skills on the job and enhance the reduction of rework and waste and give incredible recommendations when it comes to material choice, energy usage and ensuring efficiency of operations during construction (Hwang et al., 2016).

4.4.3. Setting sustainable priorities and goals early in feasibility study

To ensure sustainability of construction projects, implementing the key sustainable principles from the feasibility stage of projects cannot be overemphasised (Darko, 2019). This is because at this stage there is little or no cost implications when changes are made to the construction drawings or the choice of materials and even the processes and concepts to adopt for the building (Wu et al., 2019). Project management teams could also benefit from set sustainability goals which could enhance their decisions and initiatives in presenting and handing over projects within pre-set budgets (Zhang et al., 2011a,b).

4.5. A model for enhancing project management teams' readiness in sustainable building processes

To elaborate the findings of the study, the study presents the key findings in a conceptual model (Fig. 1). The conceptual model shows the main challenges of project management teams along four key components *viz* competency, technological maturity, cost, time and safety, and documentation. These four key components encompass all the challenges which are faced by project management teams in implementing sustainable building processes in the GCI. The four key components are the aggregative names adopted for classifying the challenges faced during sustainable building processes (Darko, 2019; Djokoto et al., 2014). To ensure sustainable building processes, the study also identified 16 mitigation strategies which when followed could help eliminate most of the challenges and lead towards the implementation of sustainable building processes in construction industry of developing countries by project management teams. These mitigating strategies are critical in leading project management teams towards a sustainable building process.

5. Conclusions

This study examines the challenges and mitigating strategies for enhancing project management teams' readiness in adopting sustainable building processes. The study highlights the challenges facing project management teams in sustainable building processes in developing countries to comprise of inadequate training and education, unfamiliarity with green technologies, and higher costs for green construction

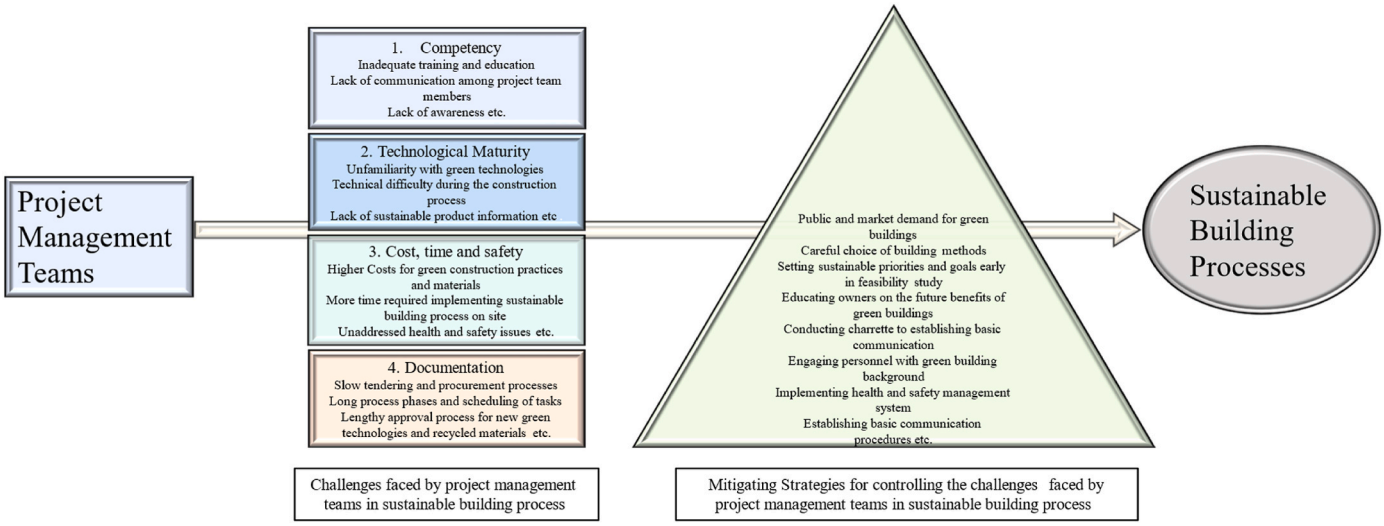

Fig. 1. Conceptual model for enhancing project management teams' readiness in sustainable building processes.

practice and materials. Also, the study expatiated that educating stakeholders on the future benefits of green buildings; engaging personnel with green building background and setting sustainable priorities and goals early in feasibility study as key strategies to mitigate the challenges faced by project management teams in sustainable building processes.

The findings of this study hold significant practical implications since identifying that most project team members are unfamiliar with sustainable building processes and also have inadequate training, educating construction professionals will aid in the successful implementation of sustainable practices within the construction industry. The study also provides stakeholders in the construction industry a guided approach on how to mitigate the challenges in adopting sustainable building practices through the adoption of the proposed strategies. Stakeholders which this study affects include clients, contractors, designers, government officials and users. For clients and government officials, strategies such as educating on the future benefits of green buildings will prepare them to appreciate this novel concept and propose their usage in building projects. While for contractors and designers, the need to establish basic communication procedures, setting sustainability priorities in the feasibility study and ensuring that professionals with background in green building are engaged for construction could boost the implementation of the concept in developing countries construction industry.

For theory, the present study is unique, since it adopted quantitative analysis which enhances the reproducibility of the findings with minimal subjective judgement. The study also solicited the expertise of 200 construction professionals who have keen knowledge in sustainable building process. The findings from the analysis could be said to be a good representation of understanding the challenges and measures to mitigate the challenges facing project management teams in sustainable building processes in Ghana. Although several studies have been done around sustainability in the construction industry, the novelty of this study lies in its ability to draw a relationship between project management teams' readiness and sustainable building processes in the perspective of the construction industry of developing countries.

Although the results provide a comprehensive understanding of the challenges that project management teams face and the strategies to mitigate those challenges, the factors identified and ranked in the study are not exhaustive to encompass all key issues in this domain relating to the developing countries' context. The understanding of the study context is paramount, and this must be taken into consideration when interpreting the results from the study. Also, the study did not strategically consider the readiness of the project management teams in sustainable building process from concepts such as teams' competencies and technological maturity, which could have enhanced the challenges and mitigation strategies to produce a much-streamlined findings. Also, not purposefully considering the study from these concepts means that some key variables might have not been explicated in detailed and this should be considered when interpreting the findings.

Therefore, future study could be done by considering the challenges and mitigating strategies for improving project management teams' readiness from key concepts such as teams' competence, documentation, and technological maturity and adopting a mixed method approach to increase the robustness of the findings and implications to other developing countries.

Declaration of competing interest

The authors have no conflicts to declare.

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