ESSENTIALS FOR GREEN BUILDING ADOPTION IN GHANA

PRINCESS ASHIORKOR NORTEY and GABRIEL NANI, Ghana

Keywords: Sustainable construction, green buildings, Ghanaian construction industry, green building adoption, promoters, implementation strategies.

SUMMARY

In order to encourage its widespread adoption in Ghana, this study sought to understand the promoters and implementation strategies of green building adoption from the perspectives of Ghanaian construction professionals. Purposive and snowball sampling was the method utilized to choose the respondents for the survey. Researchers, architects, quantity surveyors, engineers, and other construction professionals made up the population of this study. Data from a total of 134 respondents were used in the survey report's conclusion. The respondents were asked to rank the variables on a 5-point Likert scale as part of a closed-ended questionnaire that was used to collect the data. IBM SPSS and Microsoft Excel were used as the data entry and analysis tools. Cronbach's alpha coefficient of 0.950 was reached for reliability of the study. For normalcy, the Shapiro-Wilk test was applied and all variables had p-values that were less than 0.05, hence the data was not normally distributed. The one-sample t-test was also applied and findings determined that all promoters and implementation strategies were statistically significant. Using the mean score for ranking of variables, "Increasing environmental awareness among stakeholders" was the highest ranked promoter while "Increasing knowledge and awareness to clients and the public" became the highest ranked implementation strategy. In order to encourage the adoption of green buildings, stakeholders, policymakers, and activists can use the study's findings as a guide to focus their attention on specific factors with the greatest potential for impact.

1. INTRODUCTION

The building industry uses up to 36% of all energy resources and generates up to 40% of all greenhouse gas emissions globally each year, according to the United Nations Environment Programme (UNEP) (2018). Due to recent increases in industrial development, population growth, and population density, the amount of waste produced has significantly increased., which has had a negative impact on the environment and created the greenhouse effect (Sudharsan and

Sivalingam, 2019). Concerns about energy use and related pollution issues are spreading around the world (Ohene, Hsu and Chan, 2022). India, China, and the United States, who together contributed 70% of the global increase in primary energy demand, additionally caused the primary energy demand to rise by 2.3% in 2018, the biggest annual increase since 2010 (Weerasinghe, Ramachandra and Rotimi, 2021). According to the European Commission (2018), the building industry in the European Union consumes 40% of the energy generated by fossil fuels. Construction emissions are strongly linked to life and work since they essentially relate to the resource consumption and greenhouse gas generation that occurs during the lifecycle of a structure (Li et al., 2014). Because of the enormous demands made by the construction sector, resources and the environment are under a great deal of stress (Darko and Chan, 2017).

Between 20% and 30% more people will inhabit the planet in 2050 than there were in 2020 (United Nations Department of Economic and Social Affairs, 2021). It is anticipated that Sub-Saharan Africa, the region with the highest rate of urbanization, will have a population rise in its metropolitan areas that will be twice as large during the next 25 years (Saghir and Santoro, 2018). Due to increased time spent within buildings and the expanding population, there is a high need for building services as well as an improvement in comfort (Chua et al., 2013). Hence, it is imperative to create strategies for lessening how negatively the construction sector affects the environment (Xu et al., 2022). The construction sector, one of the major producers of carbon emissions, has looked for numerous cutting-edge methods to conserve energy, cut carbon emissions, and lessen the environmental effects of construction (Chen et al., 2022). One of the key advancements made possible by the construction industry is green building (Chen et al., 2022). According to prior studies, green buildings might, in the areas of water use, solid waste management, and transportation, cut carbon emissions by 50%, 48%, and 5%, respectively, compared to conventional structures (Mozingo and Arens, 2014). Sustainability should be attained while meeting these population demands through development, taking into account the fact that people are continually seeking progress in all areas of life, including but not limited to the construction sector, which is constantly looking for ways to satisfy man's second-most important need i.e. housing (Klarin, 2018). Green buildings have drawn a lot of attention in the global discourse on sustainable construction (Ofek and Portnov, 2020). The expansion of green buildings is necessary as a strategic move to reduce the negative environmental effects of construction while promoting human health and wellbeing (Ofek and Portnov, 2020). In order to achieve sustainable development on a global scale, it is imperative that green building methods and practices are used when building (Zhang, Wu and Liu, 2018). Over the past 20 years, many nations have prioritized encouraging the adoption of green building technologies due to the numerous sustainability benefits (Darko and Chan, 2018). Green building technology adoption, however, is languishing in developing nations (Nguyen et al., 2017). Particularly in the sub-Saharan Africa region, several regions of the world still experience delayed and ineffective acceptance rates for green buildings (Wuni, Shen and Osei-Kyei, 2019). A similar demand pattern has also been observed in Ghana, a developing country (Djokoto, Dadzie and Ohemeng-Ababio, 2014). Utilizing and promoting green building technology is essential in the construction sectors of developing nations like Ghana (Huang et al., 2018). Therefore, the purpose of this research is to identify and analyze the promotion and implementation strategies for the adoption of green buildings in the Ghanaian construction industry.

2. LITERATURE REVIEW

According to United Nations Department of Economic and Social Affairs (2021), the population of Sub-Saharan Africa will double between 2020 and 2050. Urbanization's rapid pace is putting tremendous pressure on already-existing facilities (Addy et al., 2020). To meet the demand caused by the rapid expansion in population, buildings must be constructed and infrastructure must be improved each year (Addy et al., 2022). The building industry in Ghana performs a poor job of minimizing its environmental impact (Ahmed, Hatira and Valva, 2014). Rapid urbanization and population increase, which are causing unsanitary living conditions, a shortage of housing options, and high housing costs, are major factors in Ghana's environmental effect (Ahmed, Hatira and Valva, 2014). The building industry is putting a lot of attention these days on embracing the sustainable development due to increased public awareness of these environmental concerns (Darko and Chan, 2018). Although adoption of green construction technologies has been slow and is still in its early stages (Darko et al., 2018), Ghana, one of the few developing nations, is making an effort to advance its use and development (Darko, 2019). At this early stage, developing countries must expand their use of promotion tactics for green building (Darko and Chan, 2018). How to increase the widespread application of green construction methods in the building process has drawn a lot of interest from academics and practitioners in the industry.

2.1 Promoters of Green Building

There have only been a few modest initiatives made for a better understanding of the strategies used to promote the use of green building technologies in developing countries (Darko and Chan, 2018). In Singapore, three of the most practical strategies for promoting the use of green commercial grounds were determined to include public co-financing, incentives, and laws and regulations governing green development (Hwang, Zhu and Ming, 2017). Wong, Chan and Wadu (2016) also conducted research in Hong Kong on the many factors that make it easier to implement the use of green purchasing in construction developments and they identified the three most important factors as the government's mandatory environmental regulation, the specifications of the government, NGOs, and clients when tendering. Additionally, it is acknowledged that one of the strategies for promoting the use of green and sustainable buildings is government support for green building research and development (R&D) (Qian and Chan, 2010). Research on methods for green building certification led researchers to the conclusion that developing such systems is essential for promoting the expansion of green construction globally (Doan et al., 2017; Li et al., 2017). Li et al., (2022) also found that increasing local government subsidies for green building initiatives led to the development of additional green buildings.

An advertising strategy used to compare the promotion of building energy efficiency in China, Canada, the United States, and the United Kingdom was the provision of low-interest loans for the implementation of building energy efficiency (Qian and Chan, 2010). Van Doren et al. (2016) also developed strategies to hasten the growth of energy-saving initiatives in Valencia, Spain, and

Utrecht, Netherlands, which included the creation of private and governmental funding mechanisms. According to a Hong Kong study, a number of factors help building projects implement green procurement, and lifecycle considerations have been identified as one of the main enablers (Wong, Chan and Wadu, 2016). Potbhare, Syal and Korkmaz (2009) also highlighted better access to cost and benefit information as a key promotion strategy. Desired green materials that are readily available and competitively priced tend to promote the adoption of green buildings (Bond, 2010). Collaborating with academic institutions to study the benefits of such gardens was discovered to be one of the three widely used practical tactics in the promotion of the implementation of green gardens in Singapore (Hwang, Zhu and Tan, 2017). Hwang and Tan (2012) also emphasized strategies to promote the usage of green buildings, such as creating a framework for managing green building initiatives. Raising public knowledge of environmental issues through seminars, conferences, and workshops was mentioned as one promotion technique to help India implement green construction concepts (Potbhare, Syal and Korkmaz, 2009). One strategy to promote the adoption of green buildings included educating clients about their advantages as well as planning construction visits to inform communities about the benefits of green buildings (Hwang and Tan, 2012). Van Doren et al. (2016) also created techniques such as training and educating stakeholders on energy conservation initiatives in order to speed the spread of energy-saving operations in the Netherlands and Spain. One of the most important facilitator identified to assist in the introduction of green procurement practices in Hong Kong in construction developments was executive management commitment (Wong, Chan and Wadu, 2016).

2.2 Implementation Strategies for Green Building Adoption

Darko, Zhang and Chan (2017) identified publicly honoring and rewarding green building technology adopters as a measure that may be utilized to implement the adoption of green buildings since company identity, viewpoint, and tradition are among the key motivators in doing so. Adoption of the green building is also encouraged by the potential for better marketability of green suppliers, which might help businesses by expanding their market as a significant element of their commercial strategy. By utilizing resource-efficient approaches and integrated design, it is frequently able to reduce expenses on more expensive electrical, structural, and mechanical systems. Stakeholders may be encouraged to adopt green building principles to their projects because integrated design is a critical component of green buildings and has the potential to reduce costs while also increasing design quality (Yudelson, 2009). Government regulations and policies, according to a substantial body of earlier research, are important drivers that motivate investors to act sustainably (Boyle and McGuirk, 2012) since they have an impact on and put pressure on all main construction stakeholder groups (Sayce, Ellison and Parnell, 2007). In many countries and cities, local governments offer incentive programs to promote green development, making it more alluring (Darko et al., 2017). Financial incentives and special interest rates are two of the most sought-after forms of monetary rewards in Japan that can entice project investors and support green building (Wong and Abe, 2014). Consumer demand and desire also determine the extent of green building development. The expertise, supply, method, value, and costs are all closely related to the needs of the client (Häkkinen and Belloni, 2011). If clients and the general public are more informed and aware of a thorough understanding of the benefits of these measures, they are likely to be persuaded to choose green construction despite the costs (Darko et al., 2017). In literature, there has been a lot of emphasis placed on the finding that green rating or certification is also one of the primary external motivations for the creation of green buildings (Li et al., 2014; Doan et al., 2017).

3. Research Methodology

Seventeen (17) promoters and seven (7) implementation strategies were found during the literature review that served as the foundation for the design of the questionnaire. To acquire knowledgeable opinions on the topic under inquiry from the construction industry, a quantitative technique was applied. An empirical questionnaire survey was done after the initial tactics were developed to obtain expert opinions on their relative importance. The chance to attain quantifiability and objectivity is provided by the administration of questionnaire surveys (Ackroyd and Hughes, 1992). In the field of green building research, the approach of questionnaire survey has been widely used (Darko and Chan, 2018; Addy et al., 2022). The population consisted of specialists in the field who are knowledgeable about utilizing green construction practices in Ghana (Darko and Chan, 2018). The sample was a nonprobability sample since the study lacked a sampling frame (Zhao. Et al., 2015). In situations when the study population is poorly defined or unstructured, non-probability sampling is thought to be beneficial in order to obtain a representative sample and reduce bias (TenHouten, 2017). Professionals with knowledge of and experience in implementing green construction practices in Ghana were among the selection criteria used to choose the purposive sample. It was challenging to estimate the size of this community because there is no database or institution that offers straightforward access to it. There was also usage of the snowballing strategy. The method of non-probability sampling known as "snowball sampling" comprises using existing units to find new ones in order to build the sample (Pandey and Pandey, 2015). When it is impossible to choose respondents from the population using a random sample method, it is suitable to choose respondents instead based on their interest in participating in the research study. This strategy, which allows for the gathering and sharing of data and responses through referral or social networks, was also employed in earlier construction engineering and management research (Zhang, Shen and Wu, 2011). To find the initial responses, local stakeholders who had been involved in the development of green building projects or research in Ghana were contacted (Darko and Chan, 2018). The responders who were initially contacted were invited to provide details about further informed participants. Over the course of 5 months, 134 replies were received in total. 134 people make up the study's sample size. Both in-person and online surveys were distributed using Google Forms. Reviewing these responses revealed that one was lacking because participants in the study who had very little expertise of green construction were not allowed to participate.

4. Data Analysis

A reliability test (Cronbach's Alpha coefficient) was conducted on the items and variables utilized in the study prior to the analysis. This test was designed to examine the consistency and dependability of the answers provided using the Likert scale. Generally, if the Cronbach statistic is larger than 0.7, reliability has been demonstrated. The computed coefficient of the questionnaire survey was 0.950, according to a Cronbach's alpha reliability analysis. This indicates a high reliability of data.

Secondly, a normality test was performed. To check for normalcy, the Shapiro-Wilk test was applied. For determining whether data is normal, this has been widely employed. The test was conducted with an alpha value of 0.05. If the post-test p-values are higher than the chosen alpha value, the data set is said to be normally distributed. The Shapiro-Wilk test was applied because there were 134 sample members, and all variables had p-values that were less than 0.05 as a result. The null hypothesis was therefore disproved.

The one sample t-test is the next analysis performed. As a result, the alternative hypothesis, H1, is that "the mean value is statistically significant," as opposed to the null hypothesis, H0, "the mean value is not statistically significant." If the p-value is less than 0.05, the null hypothesis should be disregarded. The test value of 3.50 was used to determine the significance of the mean scores. Because the p-values for these variables were less than 0.05, the one-sample t-test findings determined that all promoters and implementation strategies were statistically significant.

VARIABLE	CATEGORIES	FREQUENCY	PERCENTAGE (%)
Professional Background	Researcher	27	20.1
	Industry Practitioner	76	56.7
	Both	31	23.1
	Total	*134*	*100.0%*
Background of Knowledge in Sustainable Construction	Theoretical	57	42.5
	Practical	48	13.4
	Both	59	44
	Total		
Highest Academic Qualification	Undergraduate degree	49	36.6
	Masters degree	75	56
	Doctorate degree (PhD)	10	7.5
	Total	*134*	*100.0%*
Profession of Respondents	Architect	33	24.6
	Quantity Surveyor	31	23.1
	Engineer	28	20.9
	Construction Manager	30	22.4
	Planner	5	3.7
	Researcher	4	3.0
	Other	3	2.2
	Total	*134*	*100.0%*
Company Description of Respondents	Consulting Firm	62	46.3
	Contracting Firm	48	35.8
	Researching Firm	20	14.9
	Supplier	2	1.5
	Other	2	1.5
	Total	*134*	*100.0%*
Years of Work Experience	1 – 5 years	78	58.2
	6 – 10 years	34	25.4
	11 – 15 years	13	9.7
	16 – 20 years	3	2.2
	Over 20 years	6	4.5
	Total	*134*	*100.0%*
Level of Knowledge of Green Buildings	Very Low	1	.7
	Low	10	7.5
	Medium	48	35.8
	High	60	44.8
	Very High	15	11.2
	Total	*134*	*100.0%*

Table 1:Demographic Data of Respondents

The extent of agreement or disagreement on the variables was then determined by computing the mean scores for each of the variables. The techniques to promote the use of GBTs were ranked in descending order of importance, as assessed by the respondents, using the two most popular descriptive statistics, mean and standard deviation (SD). According to the questionnaire, a mean must have a value greater than 3.5 in order to be considered meaningful because a mean of 3 is regarded as neutral. The strategy with the smallest standard deviation was awarded the highest rank when two or more strategies had the same mean score in accordance with Mao et al.'s [41] methodology. The average is more likely to be reliable for the majority if the standard deviation is lower, which indicates that the disparities in responses were not statistically significant.
The table below lists each promoter's significance based on the mean score analysis.

Promoters	N	Std. Deviation	Mean	Ranking
Increasing environmental awareness among stakeholders	133	.776	4.20	1st
Providing stakeholders with green technology education and training	133	.806	4.16	2nd
Promoting their advantages to customers and the general public	133	.878	4.10	3rd
Partnering with research institutions to conduct research on green buildings	133	.921	4.03	4th
Green building specifications of the clients when tendering	133	.977	4.03	5th
The dedication of senior management towards adopting green buildings	133	.896	4.02	6th
Developing a framework for managing green building projects	133	.900	3.98	7th
Easily accessible and reasonably priced green materials	133	1.059	3.98	8th
Existence of green building certification systems	133	.956	3.95	9th
Considerations for the lifecycle of green buildings	133	.963	3.93	10th
Existence of green development laws and regulations	133	1.020	3.92	11th
Access to cost and benefit information for green buildings	133	1.011	3.91	12th
Government support for green building research and development (R&D)	133	1.043	3.86	13th
Government subsidies in the adoption of green building technologies	133	1.113	3.86	14th
Existence of private and public funding sources for green buildings	133	1.004	3.85	15th
Existence of government's co-funding and incentives	133	1.058	3.77	16th
Low interest loans for the construction of green buildings	133	1.154	3.74	17th

Table 2: Survey results of the promoters of green building adoption in Ghana

The table below lists each implementation strategy's relative value as determined by the mean score analysis.

Implementation Strategies	N	Std. Deviation	Mean	Ranking
Increasing knowledge and awareness to clients and the public	133	.712	4.44	1st
Improving marketability of green suppliers	133	.769	4.35	2nd
Developing green building rating systems	133	.691	4.32	3rd
Using an integrated design approach in early phases to lower costs	133	.711	4.32	4th
Promoting and rewarding green building practices publicly	133	.799	4.31	5th
Provision of market incentives such as financial and preferential interest rates	133	.736	4.29	6th
Creation of green building legislation and policies	133	.799	4.24	7th

Table 3: Survey results of the implementation strategies for green building adoption in Ghana

5. Discussion of Results

5.1 Promoters of Green building adoption in the Ghanaian Construction Industry

According to the study, the promoters' average ratings range from 3.74 to 4.20. It should be noticed that the mean scores of all 17 promoters exceeded the test result of 3.50, making each of them important. "Increasing environmental awareness among stakeholders" had the highest score and had a mean of 4.20. This was identified by (Darko and Chan, 2018) as the primary motivator for Ghana to adopt green construction practices. The next top promoters of green building adoption included: "Providing stakeholders with green technology education and training"; "Promoting their advantages to customers and the general public"; Partnering with research institutions to conduct research on green buildings"; and "Green building specifications of the clients when tendering." With mean scores of 3.85, 3.77, and 3.74, respectively, "Existence of Private and Public Funding Sources for Green Buildings", "Existence of Government's Co-Funding and Incentives", and "Low Interest Loans for the Construction of Green Buildings" were ranked last. The fact that each one exceeds the 3.50 mean criterion makes them all significant, nevertheless. Qian and Chan, (2010) offered "Low interest loans for the construction of green buildings" to encourage building energy efficiency in China, but the survey reveals that Ghanaian construction experts believed it would be the least effective compared to the other identified options.

5.2 Implementation Strategies for green building adoption in Ghana

The study found that the implementation strategies' average ratings ranged from 4.24 to 4.44. It should be noted that all 7 strategies were statistically significant because their means were greater than the test result of 3.50. Even if each technique was important, ranking them would aid stakeholders, policymakers, and activists in determining which strategies are worth their time in order to encourage the use of green buildings. The strategy with the highest mean score, "Increasing knowledge and awareness to clients and the public" came in first with a score of 4.44. Similar research showed that interacting with the public and clients about the green building concept, its benefits, and the necessity to put it into practice can increase understanding of the concept and its uptake (Darko and Chan, 2018). The mean values for "Provision of market incentives such as financial and preferential interest rates" and "Creation of green building legislation and policies" were 4.29 and 4.24, respectively. Although they received the lowest ranks, these strategies are essential and may be utilized as measures to encourage the widespread adoption of green buildings because their means are over 4.00.

6. Conclusion

This paper presents the findings of a survey investigating the range of experiential boosters and implementation strategies to the adoption of green buildings in Ghana. From the perspectives of engineers, quantity surveyors, researchers, and architects, among others, the criticalities of selected promoters have been assessed. Considering how all professionals ranked, "Increasing environmental awareness among stakeholders," "Providing stakeholders with green technology education and training"; "Promoting their advantages to customers and the general public"; Partnering with research institutions to conduct research on green buildings"; and "Green building specifications of the clients when tendering" are the top five promoters of green building adoption in Ghana. For the implementation strategies to increase the intake for green building adoption, "Increasing knowledge and awareness to clients and the public," "Improving marketability of green suppliers," and "Developing green building rating systems" were most significant. As a result of the significant results for all identified variables, it can be concluded that the success of green buildings in the Ghanaian construction industry depends on a variety of factors, including those that can be attributed to the government, clients, suppliers, researchers, financing institutions, designers and engineers, and professional bodies. The results of this study were correctly understood in the context of Ghana, which can be different from the conditions in other countries. The study's author suggests conducting additional research in various urban and rural environments as well as in other African nations.

REFERENCES

Ackroyd, S. and Hughes, J.A., 1992. Data collection in context (p. 3). London: Longman.

Addy, M., Adinyira, E., Danku, J.C. and Dadzoe, F., 2020. Impediments to the development of the green building market in sub-Saharan Africa: the case of Ghana. *Smart and Sustainable Built Environment*, 10(2), pp.193–207. https://doi.org/10.1108/SASBE-12-2019-0170.

Addy, M.N., Adinyira, E., Dadzoe, F. and Opoku, D., 2022. The Market for Green Buildings in Sub-Saharan Africa: Experts Perspective on the Economic Benefits in Ghana. *Journal of Construction in Developing Countries*, [online] 27(1), pp.173–188. https://doi.org/10.21315/jcdc2022.27.1.10.

Ahmed, K., Hatira, L. and Valva, P., 2014. *The Construction Industry in Ghana, West Africa*. [online] Available at: <https://www.diva-portal.org/smash/get/diva2:829734/FULLTEXT01.pdf>.

Bond, S., 2010. Lessons from the leaders of green designed commercial buildings in Australia. *Pacific Rim Property Research Journal*, 16(3), pp.314–338. https://doi.org/10.1080/14445921.2010.11104307.

Boyle, T. and McGuirk, P., 2012. The Decentred Firm and the Adoption of Sustainable Office Space in Sydney, Australia. *Australian Geographer*, 43(4), pp.393–410. https://doi.org/10.1080/00049182.2012.731304.

Chen, L., Chan, A.P.C., Owusu, E.K., Darko, A. and Gao, X., 2022. *Critical success factors for green building promotion: A systematic review and meta-analysis*. *Building and Environment*, https://doi.org/10.1016/j.buildenv.2021.108452.

Chua, K.J., Chou, S.K., Yang, W.M. and Yan, J., 2013. Achieving better energy-efficient air conditioning – A review of technologies and strategies. *Applied Energy*, 104, pp.87–104. https://doi.org/10.1016/J.APENERGY.2012.10.037.

Darko, A., 2019. Adoption of Green Building Technologies in Ghana: Development of a Model of Green Building Technologies and Issues Influencing Their Adoption. p.319.

Darko, A. and Chan, A.P.C., 2017. *Review of Barriers to Green Building Adoption*. *Sustainable Development*, https://doi.org/10.1002/sd.1651.

Darko, A. and Chan, A.P.C., 2018. Strategies to promote green building technologies adoption in developing countries: The case of Ghana. *Building and Environment*, [online] 130(December 2017), pp.74–84. https://doi.org/10.1016/j.buildenv.2017.12.022.

Darko, A., Chan, A.P.C., Gyamfi, S., Olanipekun, A.O., He, B.J. and Yu, Y., 2017. Driving forces for green building technologies adoption in the construction industry: Ghanaian perspective. *Building and Environment*, 125, pp.206–215. https://doi.org/10.1016/j.buildenv.2017.08.053.

Darko, A., Chan, A.P.C., Yang, Y., Shan, M., He, B.J. and Gou, Z., 2018. Influences of barriers, drivers, and promotion strategies on green building technologies adoption in developing countries: The Ghanaian case. *Journal of Cleaner Production*, [online] 200, pp.687–703. https://doi.org/10.1016/j.jclepro.2018.07.318.

Darko, A., Zhang, C. and Chan, A.P.C., 2017. Drivers for green building: A review of empirical studies. *Habitat International*, [online] 60, pp.34–49. https://doi.org/10.1016/j.habitatint.2016.12.007.

Djokoto, S.D., Dadzie, J. and Ohemeng-Ababio, E., 2014. Barriers to sustainable construction in the ghanaian construction industry: Consultants perspectives. *Journal of Sustainable Development*, 7(1), pp.134–143. https://doi.org/10.5539/jsd.v7n1p134.

Doan, D.T., Ghaffarianhoseini, A., Naismith, N., Zhang, T., Ghaffarianhoseini, A. and Tookey, J., 2017. A critical comparison of green building rating systems. *Building and Environment*, [online] 123, pp.243–260. https://doi.org/10.1016/j.buildenv.2017.07.007.

Van Doren, D., Giezen, M., Driessen, P.P.J. and Runhaar, H.A.C., 2016. Scaling-up energy conservation initiatives: Barriers and local strategies. *Sustainable Cities and Society*, [online] 26, pp.227–239. https://doi.org/10.1016/j.scs.2016.06.009.

Häkkinen, T. and Belloni, K., 2011. Barriers and drivers for sustainable building. *Building Research and Information*, 39(3), pp.239–255. https://doi.org/10.1080/09613218.2011.561948.

Huang, L., Krigsvoll, G., Johansen, F., Liu, Y. and Zhang, X., 2018. *Carbon emission of global construction sector*. *Renewable and Sustainable Energy Reviews*, https://doi.org/10.1016/j.rser.2017.06.001.

Hwang, B.-G., Zhu, L. and Ming, J.T.T., 2017. Factors Affecting Productivity in Green Building Construction Projects: The Case of Singapore. *Journal of Management in Engineering*, 33(3). https://doi.org/10.1061/(asce)me.1943-5479.0000499.

Hwang, B.G. and Tan, J.S., 2012. Green building project management: Obstacles and solutions for sustainable development. *Sustainable Development*, 20(5), pp.335–349. https://doi.org/10.1002/sd.492.

Hwang, B.G., Zhu, L. and Tan, J.S.H., 2017. Green business park project management: Barriers and solutions for sustainable development. *Journal of Cleaner Production*, [online] 153, pp.209–219. https://doi.org/10.1016/j.jclepro.2017.03.210.

Klarin, T., 2018. The Concept of Sustainable Development: From its Beginning to the Contemporary Issues. *Zagreb International Review of Economics and Business*, 21(1), pp.67–94. https://doi.org/10.2478/zireb-2018-0005.

Li, X., Wang, C., Kassem, M.A., Liu, Y. and Ali, K.N., 2022. Study on Green Building Promotion Incentive Strategy Based on Evolutionary Game between Government and Construction Unit. *Sustainability (Switzerland)*, 14(16). https://doi.org/10.3390/su141610155.

Li, Y., Chen, X., Wang, X., Xu, Y. and Chen, P.H., 2017. A review of studies on green building assessment methods by comparative analysis. *Energy and Buildings*, [online] 146, pp.152–159. https://doi.org/10.1016/j.enbuild.2017.04.076.

Li, Y., Yang, L., He, B. and Zhao, D., 2014. Green building in China: Needs great promotion. *Sustainable Cities and Society*, 11, pp.1–6. https://doi.org/10.1016/j.scs.2013.10.002.

Mozingo, L. and Arens, E., 2014. Quantifying the Comprehensive Greenhouse Gas Co- Benefits of Green Buildings. *Center for the Built Environment, UC Berkeley*. [online] Available at:

<www.escholarship.org/uc/item/935461rm>.

Nguyen, H.T., Skitmore, M., Gray, M., Zhang, X. and Olanipekun, A.O., 2017. Will green building development take off? An exploratory study of barriers to green building in Vietnam. *Resources, Conservation and Recycling*, 127, pp.8–20. https://doi.org/10.1016/j.resconrec.2017.08.012.

Ofek, S. and Portnov, B.A., 2020. Differential effect of knowledge on stakeholders' willingness to pay green building price premium: Implications for cleaner production. *Journal of Cleaner Production*, [online] 251, p.119575. https://doi.org/10.1016/j.jclepro.2019.119575.

Ohene, E., Hsu, S.C. and Chan, A.P.C., 2022. Feasibility and retrofit guidelines towards net-zero energy buildings in tropical climates: A case of Ghana. *Energy and Buildings*, 269. https://doi.org/10.1016/j.enbuild.2022.112252.

Pandey, P. and Pandey, M.M., 2015. *Research Methodology: Tools and Techniques*. *Philadelphia's Black Mafia*. https://doi.org/10.1007/0-306-48132-4_2.

Potbhare, V., Syal, M. and Korkmaz, S., 2009. Adoption of green building guidelines in developing countries based on u.s. and india experiences. *Journal of Green Building*, 4(2), pp.158–174. https://doi.org/10.3992/jgb.4.2.158.

Qian, Q.K. and Chan, E.H.W., 2010. Government measures needed to promote building energy efficiency (BEE) in China. *Facilities*, 28(11), pp.564–589. https://doi.org/10.1108/02632771011066602.

Saghir, J. and Santoro, J., 2018. Urbanization in Sub-Saharan Africa. Meeting Challenges by Bridging Stakeholders. *Center for Strategic & International Studies*, [online] (April), pp.1–7. Available at: <http://thegreentimes.co.za/wp-content/uploads/2019/03/Urbanization-in-Sub-Saharan-Africa.pdf%0Ahttps://www.csis.org/analysis/urbanization-sub-saharan-africa>.

Sayce, S., Ellison, L. and Parnell, P., 2007. Understanding investment drivers for UK sustainable property. *Building Research and Information*, 35(6), pp.629–643. https://doi.org/10.1080/09613210701559515.

Sudharsan, N. and Sivalingam, K., 2019. Potential utilization of waste material for sustainable development in construction industry. *International Journal of Recent Technology and Engineering*, 8(3), pp.3435–3438. https://doi.org/10.35940/ijrte.C5062.098319.

TenHouten, W.D., 2017. Site Sampling and Snowball Sampling - Methodology for Accessing Hard-to-reach Populations. *BMS Bulletin of Sociological Methodology/ Bulletin de Methodologie Sociologique*, 134(1), pp.58–61. https://doi.org/10.1177/0759106317693790.

United Nations Department of Economic and Social Affairs, 2021. *Global Population Growth and Sustainable Development*. [online] *United Nations*. Available at: <www.unpopulation.org.>.

Weerasinghe, A.S., Ramachandra, T. and Rotimi, J.O.B., 2021. Comparative life-cycle cost (LCC) study of green and traditional industrial buildings in Sri Lanka. *Energy and Buildings*, [online] 234, p.110732. https://doi.org/10.1016/j.enbuild.2021.110732.

Wong, J.K.W., Chan, J.K.S. and Wadu, M.J., 2016. Facilitating effective green procurement in construction projects: An empirical study of the enablers. *Journal of Cleaner Production*, [online] 135, pp.859–871. https://doi.org/10.1016/j.jclepro.2016.07.001.

Wong, S.C. and Abe, N., 2014. Stakeholders' perspectives of a building environmental assessment method: The case of CASBEE. *Building and Environment*, [online] 82, pp.502–516. https://doi.org/10.1016/j.buildenv.2014.09.007.

Wuni, I.Y., Shen, G.Q.P. and Osei-Kyei, R., 2019. *Scientometric review of global research trends on green buildings in construction journals from 1992 to 2018*. *Energy and Buildings*, https://doi.org/10.1016/j.enbuild.2019.02.010.

Xu, P., Zhu, J., Li, H., Wei, Y., Xiong, Z. and Xu, X., 2022. Are bamboo construction materials environmentally friendly? A life cycle environmental impact analysis. *Environmental Impact Assessment Review*, [online] 96, p.106853. https://doi.org/10.1016/j.eiar.2022.106853.

Yudelson, J., 2009. *GREEN BUILDING THROUGH INTEGRATED DESIGN*. *Construction*. McGraw-Hill Companies.

Zhang, L., Wu, J. and Liu, H., 2018. *Turning green into gold: A review on the economics of green buildings*. *Journal of Cleaner Production*, https://doi.org/10.1016/j.jclepro.2017.11.188.

Zhang, X., Shen, L. and Wu, Y., 2011. Green strategy for gaining competitive advantage in housing development: A China study. *Journal of Cleaner Production*, [online] 19(2–3), pp.157–167. https://doi.org/10.1016/j.jclepro.2010.08.005.

CONTACTS

Princess Ashiorkor Nortey

Kwame Nkrumah University of Science and Technology

Kumasi, Ghana

Telephone: +233 27 033 6601

Email: norteyashiorkor@gmail.com

Professor Gabriel Nani

Kwame Nkrumah University of Science and Technology

Kumasi, Ghana

Telephone: +233 24 362 5066

Email: gnani.cap@knust.edu.gh